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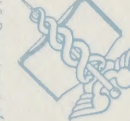
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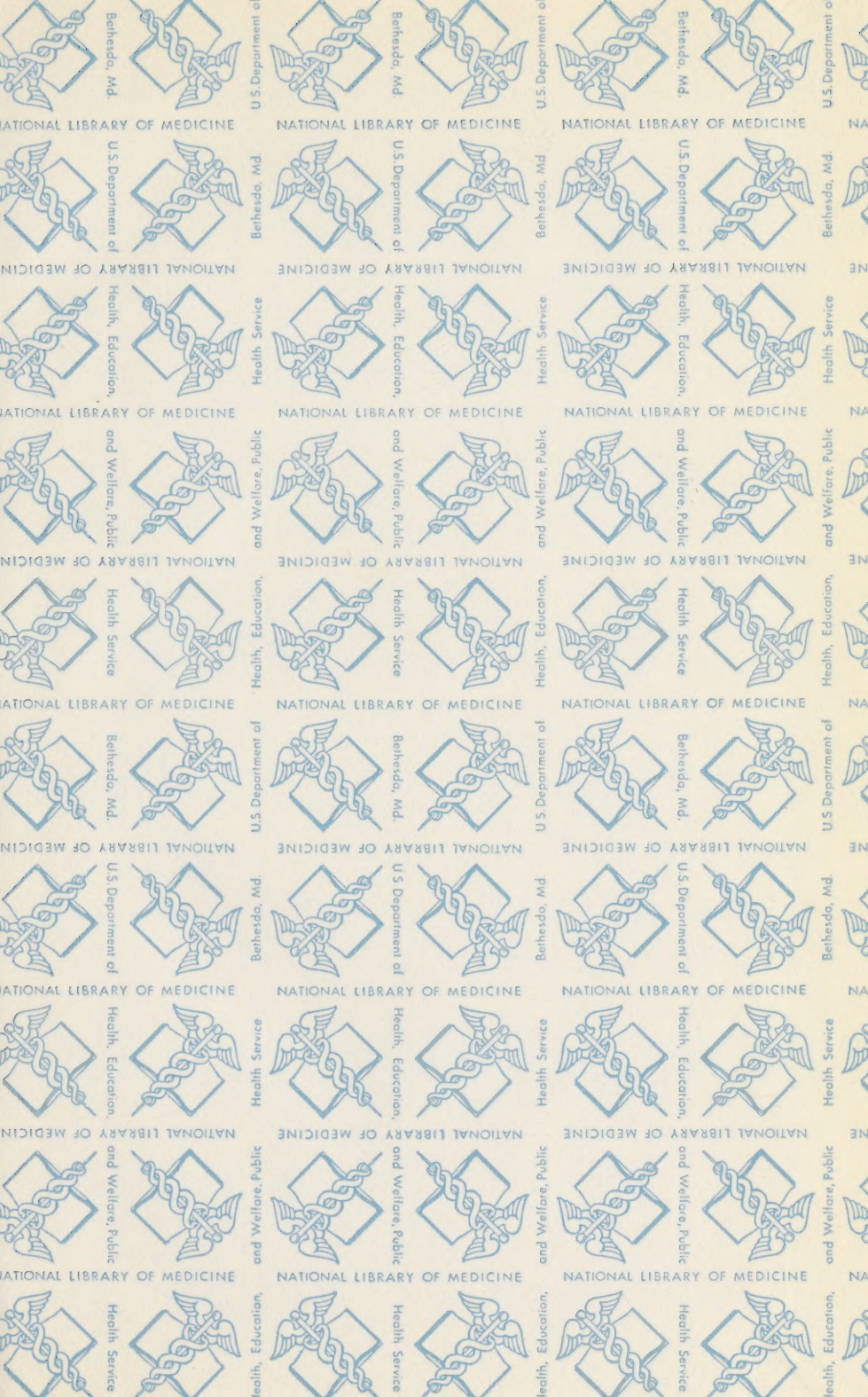
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✓
THE PHARMACEUTICAL SYLLABUS

THIRD EDITION ✓

OUTLINING COURSES OF INSTRUCTION

FOR THE DEGREES OF

GRADUATE IN PHARMACY (PH.G.)

AND

PHARMACEUTICAL CHEMIST (PH.C.)

PREPARED AND PUBLISHED

BY THE

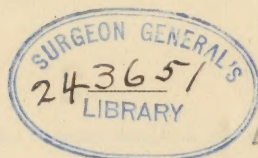
PHARMACEUTICAL SYLLABUS COMMITTEE ✓

Representing

THE AMERICAN PHARMACEUTICAL ASSOCIATION

THE AMERICAN CONFERENCE OF PHARMACEUTICAL FACULTIES

THE NATIONAL ASSOCIATION OF BOARDS OF PHARMACY



1922

[Boston, The Riverdale
press, 1922]

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1922

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1922

The committee arranged according to the associations they represent, with the years when members' terms expire and their addresses.

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1922

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Introduction

In colonial times and during the early years of the Union the practice of pharmacy in the United States was not regulated by law and training in the profession was entirely by the apprenticeship method. In 1821 the first school of pharmacy was organized and others followed until the number of schools at present is about seventy-five. Regulation of the practice of pharmacy did not begin until about 1880 by laws of the separate states, each of which now has a pharmacy law of some description on its statutes.

The development of education in pharmacy and of the regulation of its practice was highly individualistic and for many years there was no official connection between the schools of pharmacy and the licensing boards, or between the education of a pharmacist and the license to practice pharmacy. The different schools of pharmacy, however, were all working for the same end, and in 1900 several of them organized the American Conference of Pharmaceutical Faculties, which has held annual meetings since that time and is now made up of forty-six of the leading schools of pharmacy in the country. The Conference rendered a useful and important service in standardizing the curriculums in the schools of pharmacy and their requirements for entrance and graduation. The National Association of Boards of Pharmacy was organized in 1904 and now includes nearly all of the state boards of pharmacy, either as active or associate members. This Association holds annual meetings of several days' duration, and has done much to harmonize the work of the different boards of pharmacy.

As the population of the country increased and living conditions became more complex, it was found necessary to co-ordinate the work of the schools of pharmacy and the state boards of pharmacy. The first "prerequisite" of graduation from a recognized school of pharmacy, in addition to the requirements regarding character, age, and experience in retail drug stores, for admission to the examination for license to practice pharmacy was enacted by New York State

in 1904. At first, other states were slow in following this example; but it has proven its desirability and during each of the last few years several other states have fallen into line, the total number having the requirement being eighteen in 1921. At the present rate, it appears that it will not be many years before all or nearly all of the states will have established the college prerequisite in pharmacy.

When the college prerequisite in pharmacy went into effect in New York State it was immediately found necessary to determine a basis of recognition of pharmacy schools. The wide variations in the curriculums of the schools made this so difficult that the need of a *Pharmaceutical Syllabus* to outline a minimum course of study was felt. A meeting was held at Niagara Falls, New York, on June 27, 1906, by representatives of the New York State Board of Pharmacy and the American Conference of Pharmaceutical Faculties. At first it was intended to have the *Syllabus* prepared for New York State alone, by a committee of three consisting of Henry H. Rusby, representing the State Pharmacy Council; Willis G. Gregory, representing the State Board of Pharmacy; and Henry L. Taylor, representing the State Department of Education. It was soon decided, however, that the work should have a national character and during the meeting of the American Pharmaceutical Association held at Indianapolis in 1906, the National Pharmaceutical Syllabus Committee was organized and Wilhelm Bodemann, representing the National Associations of Boards of Pharmacy, and James H. Beal, representing the American Conference of Pharmaceutical Faculties, were added to the original committee. In September, 1906, it was decided to enlarge the committee to twenty-one members and the new committee was organized with Willis G. Gregory as chairman and Henry L. Taylor as secretary. In 1907 it was decided to divide the course of study into three branches, namely materia medica, chemistry, and pharmacy; and in accordance with this action, to assign seven members to each of three sub-committees to have charge of these respective branches.

The interest of the whole membership of the committee, aided by the tireless energy of its secretary, Henry L. Taylor, resulted in the early preparation of the manuscript for the

first edition of the *Syllabus* and the problem of its publication arose. At this juncture the New York State Board of Pharmacy offered to publish an edition of one thousand copies without expense to the committee. This offer was accepted and the first edition was published and distributed to the boards and schools of pharmacy of the country without expense to the committee or the recipients.

At the time the first edition of the *Syllabus* was issued in 1910 the membership of the committee was as follows:

Willis G. Gregory, *Chairman*.

Henry L. Taylor, *Secretary-Treasurer*.

SUB-COMMITTEE ON MATERIA MEDICA

Henry H. Rusby, *Chairman*; Clarence O. Bigelow, Charles T. Heller, Clement B. Lowe, Julius O. Schlotterbeck, Fred P. Tuthill, Ernest Wende.

SUB-COMMITTEE ON CHEMISTRY

Ernst O. Engstrom, *Chairman*; C. Lewis Diehl, George C. Diekman, Samuel L. Hilton, Julius A. Koch, Charles B. Sears, Henry L. Taylor.

SUB-COMMITTEE ON PHARMACY

James H. Beal, *Chairman*; William C. Anderson, Theodore J. Bradley, Charles Gietner, Willis G. Gregory, Samuel A. Grove, Oscar Oldberg.

After the first edition appeared it was clearly seen that to establish the *Syllabus* on a permanent basis it should be put into the hands of a committee representing those most interested in the work; therefore each of three national pharmaceutical bodies was requested, at the Richmond meetings in 1910, to make lasting provision for the appointment of seven members of the National Syllabus Committee.

American Pharmaceutical Association. In response to such request this organization on May 4, 1910, amended its by-laws to make permanent provision for such representation.

American Conference of Pharmaceutical Faculties. This body also arranged for permanent membership on the committee by amending its by-laws to that effect, May 4, 1910.

National Association of Boards of Pharmacy. This organization co-operated with the others by providing in its by-laws for such committee membership.

In this way the *Syllabus* has become an integral part of the structure of American pharmacy.

During 1911, after the new committee had been appointed and its members had been assigned to sub-committees, active work on the second edition was begun and the revision appeared in 1913, when the committee had the following membership:

Willis G. Gregory, *Chairman*.

Henry L. Taylor, *Secretary-Treasurer*.

SUB-COMMITTEE ON MATERIA MEDICA

Henry H. Rusby, *Chairman*; George M. Beringer, Clarence O. Bigelow, John Culley, William B. Day, Clement B. Lowe, William Mittelbach.

SUB-COMMITTEE ON CHEMISTRY

Ernst O. Engstrom, *Chairman*; William C. Anderson, Theodore J. Bradley, Charles W. Johnson, Julius A. Koch, Turner A. Miller, Henry L. Taylor.

SUB-COMMITTEE ON PHARMACY

James H. Beal, *Chairman*; Charles Caspari, Jr., Eugene G. Eberle, Charles Gietner, Willis G. Gregory, Harry B. Mason, William H. Rudder.

At the meeting held in Detroit in August, 1914, Dr. Henry L. Taylor withdrew from the office of secretary-treasurer, which he had held since the organization of the committee, the work of which advanced largely by his devotion and tireless energy. Theodore J. Bradley was elected secretary-treasurer in Dr. Taylor's place.

At the meeting held in Indianapolis in August, 1917, when plans for active work on the preparation of the third edition were formulated, Dr. Willis G. Gregory declined re-election as chairman after capable and faithful service from the first formation of the committee and Theodore J. Bradley was advanced to the chairmanship and Clyde M. Snow

was elected secretary-treasurer. The work suffered many interruptions and delays during the great war and reconstruction period, but was completed in 1922, when it is expected that this edition will appear, having been prepared and published by the committee whose membership is given on pages 3 and 4.

The aims of this work are to outline: first — a minimum course of study leading to the degree of Graduate in Pharmacy (Ph.G.), that will be broad enough and sufficiently well balanced to be acceptable to pharmacy schools as a basis for the instruction of their students and at the same time will be satisfactory to boards of pharmacy as a basis for preparing examinations for candidates for licenses as pharmacists; second — a graduate course of one year, leading to the degree of Pharmaceutical Chemist (Ph.C.), including advanced treatment of subjects studied in the undergraduate course and other related subjects; and third—a discussion, with examples, of the principles underlying the preparation of examination papers for candidates for licenses to practice pharmacy.

That the result of such work must represent more or less of compromise is apparent, but it is the well-considered product of a group of earnest workers in pharmacy and as it goes through its successive editions, each unmistakably better than the preceding one, it is believed to be approaching nearer and nearer to the ideal book which is striven for but can never be quite attained.

In the present edition the three main sections on materia medica, chemistry, and pharmacy have been largely rewritten and improved in many ways and two new sections have been added. The first of the new sections is an outline of a one-year graduate course leading to the degree of Pharmaceutical Chemist. The second of the new sections attempts to give a practical exposition of the principles underlying the preparation of examinations for candidates for licenses to practice pharmacy. The lists of reference works, text-books, and pharmaceutical periodicals, which were included in the preceding edition, have been omitted as the limited use made of them does not warrant their continuance.

This edition of the *Syllabus* was to have been in effect from 1920 to 1925 and much of the work of preparation

for it was done before the United States entered the great war, but the work had to be laid aside during the war and until the reconstruction had advanced far enough to allow the members of the committee to again take up such tasks. The delay makes it inexpedient to announce a definite date on which the edition shall become effective, but it is expected that it will be ready for use in advance of the school year of 1922-1923. As the *Syllabus* is meant to be suggestive and helpful and the use of it is voluntary, the exact date on which it becomes effective is not as important as it would be if its use were obligatory. The changes in main sections are not so extensive as to cause any serious confusion in the use of the book by boards of pharmacy as a basis for examinations before the schools of pharmacy have made their courses conform to the new outlines.

The *Pharmaceutical Syllabus* is intended to indicate the general scope and character of the instruction to be given by the teacher and the work to be done by the student. By this means it is expected that adequate attention will be given to the essentials of each subject, that approved principles of teaching will be observed, and that embarrassment to students in state board examinations arising from defective instruction or the use of different text-books may be obviated. It is not designed, however, to interfere with such flexibility in courses of study and freedom in methods of instruction as ought to exist in pharmacy schools, but to indicate subjects of study, to present outlines of these subjects, definitions of standard requirements, and topical analyses.

First Principle. This finds expression in the Committee's principle, "In the selection of matter for this necessarily restricted *Syllabus* the primary object is the treatment of the subjects in as scientific a manner as will meet the needs and convenience of the retail pharmacist."

Examinations. Examination questions are to be based upon the *Syllabus*, but the instruction of the schools and the tests of the boards may fairly be expected to give recognition to discoveries in pharmaceutical science and other important changes. Special efforts should be made to state examination questions clearly and not to assume a degree of education or skill in statement that may not reasonably be

expected from pharmaceutical students. On the other hand, the schools should contribute their share toward the success of the examinations set by the state boards by thoroughly covering the minimum course outlined and detailed in the *Syllabus*.

Second Principle. The committee is not unmindful of its own restrictions as appears from another of its principles, "While considerable attention to detail is necessary in the *Syllabus* to the end that the boards may be properly guided in their examinations, such detailed treatment should not go further than is necessary to accomplish that purpose."

A system of examinations adapted to the work of all the pharmacy schools of the United States must necessarily be somewhat different from one intended for the students of a single school. The personality of the teacher, the local environment, and the text-book used, all tend to vary the work done in the different schools. As a result the exact treatment of any subject and the emphasis given to any part of it will not be precisely the same in any two pharmacy schools. This is as it should be, for were it not so the work would lack individuality and spirit. To provide for these conditions the *Syllabus* will give in general terms very full outlines of the subjects in which examinations are held. These outlines in some subjects may be so full that it will be impossible for any one class, in the time allotted, to study exhaustively all the topics mentioned and no one text-book could furnish the material for such exhaustive study. It is here that the alternative or group system of questions may give relief.

Third Principle. "The *Syllabus* is intended to allow the individual teacher or school the widest possible liberty as to order and grouping of these topics and method of their presentation. Its object is to specify what topics are to be taught by the schools and expected by the boards without concerning itself with the manner in which this result is reached by any school, teacher, or text-book."

In short, the plan and scope of the work contemplates an outline that shall serve as a rational ground for instruction in pharmacy schools of the United States, and that shall afford permanent and scientific tests for admission to the practice of one of the most ancient and honorable branches of applied science — pharmacology.

Advantages of a National Syllabus. A national syllabus has these advantages:

It gives all the boards a uniform outline of the ground to be covered by their examinations.

It gives examinees definite knowledge of the preparation expected by the boards.

It gives the colleges a minimum outline of the ground to be covered in the preparation of their students for board examinations.

It leads to such uniformity in board examinations that the exchange of licenses becomes possible when they are based on examinations in accord with the *Syllabus*.

Schools of Pharmacy. The term "college" includes universities and other institutions of higher instruction authorized to confer degrees in arts and science. Professional and technical higher institutions are sometimes called schools whatever their corporate title. Hence the word "school" as used in this work refers uniformly to colleges or schools of pharmacy, or to the pharmacy departments of universities. This use of the word does not affect in the least the corporate title of any institution.

Definitions. The wide discrepancy in the use of pharmaceutical terms by the dictionaries, in the announcements of schools, and in the examinations set by state boards, has made formal definitions necessary. The principle on which the definitions have been chosen is an old one: not to be the first to use the new nor the last to abandon the old. For the sake of clearness and precision some general terms are defined here. Special terms are defined when first they appear in the context of succeeding chapters, and a separate glossary of the more important definitions is found on pages 150-154.

Pharmacology. This is the science that treats of drugs and medicines, their nature, preparation, administration and effect, including pharmacognosy, pharmaco-dynamics, therapy-dynamics, pharmaceutical chemistry and pharmacy.

This word is defined and used here in its general meaning, which includes all branches of study connected with drugs and medicines, but it is used by many writers in a restricted sense as equivalent to pharmaco-dynamics.

Drugs. All substances used as medicines or in the preparation of medicines are drugs. Drugs that have not been

changed by manufacture except by desiccation or comminution are crude drugs.

Medicine. A drug or preparation of drugs in suitable form for use as a curative or remedial substance is a medicine.

Suggestions Concerning Notebooks. (1) Individual notebooks should be insisted upon in all individual laboratory work. (2) Notes of experiments and of demonstrations should appear together in the notebooks in the order in which they are performed. (3) The purpose of each experiment should be clearly stated in a brief title. (4) A brief description usually accompanied by a drawing should show how the experiment is performed. Drawings should show the essential parts of the apparatus and, if possible, at the most important stage of the experiment. They should aim at accuracy rather than at artistic finish. (5) Numerical data should be recorded in tabulations. (6) Descriptions, drawings, observations and numerical data should be confined to the left-hand pages of notebooks. (7) Statements of reasoning, calculations and conclusions should be written on right-hand pages. (8) Calculations should be written out in full. (9) Conclusions should refer directly to the expressed purpose of the experiment and should follow from the data to the reasoning, as the conclusion of a proposition in geometry follows from the given conditions and the proof. (10) The experiments are regarded as fundamental. Directions should be regarded as suggestive rather than mandatory. Progressive teachers will adapt their methods to conditions existing in the school.

Suggestions Regarding Text-books. The Committee does not recommend text-books, but the courses outlined in the *Syllabus* should be based on the study of at least one standard text-book in each subject, to the end that the student may gain a comprehensive and connected view of the important facts, methods, and laws.

SECTION I

THE TWO-YEAR COURSE

LEADING TO THE DEGREE OF GRADUATE IN PHARMACY
(P.H.G.)

General Outline. The following general outline of a minimum course of study for the guidance of schools of pharmacy in the preparation of their students for the examinations of the state boards of pharmacy, is the basis for the *Syllabus* detailed in succeeding chapters.

THE MINIMUM TWO-YEAR COURSE BY BRANCHES, YEARS, HOURS AND TOTALS

Branches	1st yr.	2d yr.	Totals
I. Materia medica	200	200	400
II. Chemistry	200	200	400
III. Pharmacy	195	205	400
Totals	595	605	1,200

DETAILED ASSIGNMENT OF HOURS BY BRANCHES, SUBDIVISIONS, YEARS AND HOURS

Branch I. Materia medica	1st yr.	2d yr.	Totals
Subjects and Hours			
Pharmaceutical botany	125	....	125
Physiology	50	....	50
General principles of materia medica	10	15	25
Posology and toxicology	15	25	40
Pharmaco- and therapy-dynamics ...	....	70	70
Pharmacognosy .....	....	90	90
Totals	200	200	400

Branch II. Chemistry 1st yr. 2d yr. Totals

Subjects and Hours

Elementary physics	25	....	25
General inorganic chemistry	75	....	75
General organic chemistry .....	....	50	50
Qualitative analysis	50	25	75
Manufacturing chemistry	50	25	75
Quantitative analysis .....	....	50	50
Drug assaying .....	....	50	50
Totals	200	200	400

Branch III. Pharmacy

Subjects and Hours

Pharmaceutical arithmetic.....	30	....	30
Pharmaceutical Latin	25	....	25
Theory of pharmacy	60	....	60
Laboratory practice	20	....	20
Manufacturing pharmacy	60	60	120
Dispensing pharmacy .....	....	60	60
Commercial pharmacy .....	....	75	75
Pharmaceutical jurisprudence .....	....	10	10
Totals	195	205	400

BRANCH I—MATERIA MEDICA

Two hundred hours first year, two hundred hours second year, total four hundred hours. *Materia medica*, as understood in this *Syllabus*, treats of the physical, chemical, physiological and therapeutical properties of medicines.

Certain general facts, on which the entire course is based, should be borne in mind during the consideration of the details.

Only 400 hours are allowed for lectures, recitations, and laboratory work in botany, physiology, microscopy, pharmacognosy, pharmaco-dynamics, therapy-dynamics, posology and toxicology. We are obliged, therefore, to restrict the *Syllabus* to those portions of each of the subordinate subjects which are requisite for an understanding of the final teaching in pharmacognosy, *materia medica*, and toxicology.

FIRST YEAR

The instruction of the first year includes pharmaceutical botany one hundred twenty-five hours, physiology and hygiene fifty hours, general principles of *materia medica* ten hours, and posology fifteen hours.

PHARMACEUTICAL BOTANY. One hundred and twenty-five hours.

Botany treats of the structure, growth and classification of plants.

Pharmaceutical botany is botany studied specially as a preparation for pharmacognosy and *materia medica*. Work in this department, because of the laboratory facilities required, falls naturally into two divisions, namely the study of the gross structures of the plant and that of its cellular constitution and structure. In the lecture course, the study of the organs should be pursued, so far as practicable, from both points of view concurrently.

MACROSCOPICAL OR GROSS STRUCTURE OF PLANTS. Sixty-five hours.

Although much instruction regarding the morphology and physiology of the organs studied may properly be given in the lectures of this course, it is understood that the tissues

themselves are to be studied objectively in the separate laboratory course in vegetable histology. The special purpose of the course in gross structure is the teaching of descriptive botany, to the end that the student may become familiar with the meaning and correct use of the terms employed in describing drugs and plants. It is relatively of little importance at what point in the circle of germination, growth and seed-production a beginning is made, except as the respective conditions of season, method of illustration and facilities for study may determine.

Germination of the seed

- Conditions and process

- Root and shoot

- Epicotyl and hypocotyl

- Cell division, growth and formation of tissue

- Meristem and its direction of development

- Position of growing point and exact region of elongation

- Influence of gravity and moisture upon direction of growth

Structure of root of dicotyledons

- Fundamental or primary and permanent or secondary tissues

Fundamental or primary tissues

- Dermatogen, periblem, plerome

Dermatogen and primary structures developed from it

- Root-cap, piliferous layer, epidermis

- Their functions

Periblem and primary structures developed from it

- Hypoderm, endoderm, primary cortex

Plerome and primary structures developed from it

- Phloem, xylem

- Radial structure

Permanent or secondary structures

- In periblem region

- Phellogen, cork, secondary cortex

- Inner and outer bark

- In plerome region, the stele

- Completion of bundles and formation of cambium

- Pericycle, medullary rays, elimination of pith

- Reproduction of these tissues

- Origin and development of branches

- Transverse, oblique, radial, and tangential sections compared
- Gross differences between thallophytes, gymnosperms, monocotyledons and dicotyledons
- Development of stem structure as compared with that of root structure
 - Of stele
 - Pith, annual rings, alburnum, duramen, nodes, origin of branches
 - Of bark
 - Phelloderm, bork casting
 - Gymnospermic and monocotyledonary compared with dicotyledonary structures
 - Polystellar stems
- Classification of roots
 - Duration
 - Annual, biennial, perennial
 - Order
 - Primary, secondary, adventitious
 - Functions
 - Fixing, absorbing, storage
 - Consistency
 - Fleshy, woody, fibrous
 - Modified
 - Haustoria, rhizoids
 - Position
 - Aerial, subterranean
 - Form
 - Cylindrical, conical, fusiform, napiform, nodose, moniliform, tuberous, fibrous
- Official roots enumerated
- Classification of stems
 - Position
 - Aerial, subterranean
 - Duration
 - Annual, biennial, perennial
 - Order
 - Primary, secondary, adventitious
 - Functions
 - Support, absorption, storage, reproduction

Form

Cylindrical, flattened, triangular, quadrangular, sulcate, costate

Habit

Erect, ascending, decumbent, procumbent, repent, reclining, twining, scandent

Special forms

Excurrent, deliquescent, stolon, sucker, runner, thallus, frond

Mode of branching

Monopodial, sympodial

Modified

Cladophylla, thorns, tendrils, rhizomes, tubers, bulbs, corms

Developments from stem

Leaves, flowers, prickles, trichomes

Official stems enumerated

Buds, varieties of

The leaf

Development from stem

Gross parts

Pulvinus, petiole, lamina, stipules

Suppression of one or more parts

Function

Stomata, chlorophyll

Consistency

Membranaceous, coriaceous, fleshy, pellucid, pellucid-punctate

Position

Primordial, radical, cauline, rameal

Attachment

Petioled, sessile, amplexicaul, perfoliate, adnate, sheathing

Relation of blade to petiole

Cordate, peltate, winged petiole

Outline

Rotund, oval, oblong, elliptical, linear, acerose, fili-form, ovate, reniform, lanceolate, obovate, oblanceolate, spatulate, subulate, intermediate forms

The base

Regular, oblique, cuneate, acute, obtuse, rounded
truncate, cordate, auriculate, sagittate,
hastate

The summit

Cordate, retuse, truncate, rounded, acute,
acuminate, abruptly acuminate, alternate,
aristate, mucronate, cuspidate

Surface

Glaucous, glabrous, rugose, hispid, scabrous, lepi-
dote, hirsute, pilose, sericeous, tomentose, to-
mentellate, pubescent, puberulent, verrucose,
papillose, bullate, tessellated

Venation

Parallel and reticulate
Pinnate and palmate
Costate and nerved
Free and anastomosing veins
Primary, secondary, and tertiary

Margin

Revolute, involute, entire, sinuate, repand, crenate,
dentate, serrate, single and double toothing,
spinose, fimbriate, ciliate, crispate

Lobation

Incised, rounded, palmatifid, pinnatifid, pecti-
nate, runcinate, lyrate, ternate, quinate

Compound leaves

Palmate, pinnate (bi- and tri-), interrupted, tri-foliate

Parts of

Pinnae, pinnules, jugae, petiolules, stipellae

Modified

Etiolated, scarios, thorns, bladders, tendrils, scales,
leaf-scales, phyllodia

Duration

Deciduous, persistent, evergreen

Phyllotaxy

Alternate, opposite, whorled, scattered

Special forms of stipules

Leafless plants

Official leaves enumerated

Inflorescences, anthotaxy

Of one or more flowers

Flower stems

Peduncle, pedicel, scape, rachis

Ascending or centripetal forms

Raceme, spike, head, catkin, spadix, corymb, umbel,
panicle, anthodium and its parts

Descending or centrifugal forms

Cyme, fascicle, glomerule, scorpioid, raceme

Involucre, spathe

Compound inflorescence, panicle

Mixed inflorescence, thyrsus

Floral bracts, spadix, involucre

Receptacle

Anthodium; discoid, radiate and liguliflorate

Flower, general nature and homology

Parts: torus, calyx, corolla, androecium, and gynae-
cium

Epicalyx

Suppression of parts

Duplication of parts

Abortion

Metamorphosis

Alternation and anteposition of parts

Imperfect, hermaphrodite and perfect

Complete and incomplete

Regular and irregular

Symmetrical and asymmetrical

Appendaging

Adnation and connation, freedom and distinction of parts

Hypogynous, perigynous and epigynous parts

Perigone or floral envelopes: sepals and petals, calyx
lobes and corolla lobes

Choripetalous and gamopetalous

Tube, throat, limb, margin

Unguiculate petal and corona, papilionaceous
corollaAppendages of perigone: auricle, sac, spur, horn, cauda,
awn, palate, hood, crest, keel

Gamopetalous forms: rotate, crateriform, hypocrateriform, cupulate, turbinate, campanulate, urceolate, infundibular, cylindraceous, prismatic, ovoid, globular, gibbous, saccate, spurred, bilabiate, ringent, personate, ligulate

Duration of perigone

Caducous, fugacious, deciduous, persistent

Praefloration

Open, valvate (induplicate and reduplicate), imbricate plicate, convolute, crumpled

Androecium

Two sets of stamens

Effects of duplication by chorisis, by metamorphosis

Effects of connation

At different points

Monadelphism, diadelphism, etc.

Effects of adnation, gynandry

Stamen

Filament, connective, anther, thecae, locelli

Dehiscence of anthers, sutures, pores, valves

Introrse and extrorse

Attachments of anther: innate, adnate, incumbent, versatile, sagittate, semicircular, horizontal

The one-celled anther

Appendages to different parts of stamen

Development of pollen grains

Extine, intine, contents, various forms, germination

Pollinia and pollinaria

Staminodia: as glands

Gynaecium

Of separate pistils (apocarpous)

Each of one carpel

Effects of suppression

Ovary, style, stigma

Stigmatic surface, style, tissue and canal

Of a syncarpous pistil

Effects of adhesion, inferior ovary

Forms of ovary, style and stigma

- Ovaries with central placentae, free central placenta
- Ovaries with parietal placentae
- Extension of placenta with additional series of ovules
- Suppression of walls of ovary
- Position of ovules; erect, ascending, horizontal, pendulous and suspended
- False ovarian walls and chambers
- Pistil in gymnosperms
- Torus
 - Elongation and production of phores
 - Carpophore
 - Shortening, with resulting adhesion of parts
 - Hollow torus, disk, forms of fleshy torus
- Pollination defined
- General principles of pollination
 - Pollen grain a microspore
- Self-pollination (cleistogamy)
- Cross-pollination
- Anemophilous and entomophilous flowers
 - Pollination by birds, by water currents
- Adaptations for anemophily in stamen, pollen, stigma and habits of plants
- Adaptations for entomophily
 - Attraction of insects by color, form, odor and food supply
 - Utilization of visit of insect by dichogamy, dimorphism and trimorphism
 - Provisions preventing self-pollination
 - Mechanical distribution of pollen
- Fertilization
 - Structure of microspore, fixation on stigma, germination
 - Descent of pollen tube (prothallium)
 - Gametophyte and gametes
- Development and structure of ovule
 - Funiculus, coats, nucellus, chalaza, foramen, raphe
- Forms of ovules
 - Atropous, anatropous, amphitropous, campylotropous

Structure of nucellus

Macrospore or megaspore

Development of female gametophyte and gamete

Effect of fertilization, formation of embryo (return to seed)

Fruit and fructification

Objects of fructification

Nourishment, protection and distribution of seed

Product includes pericarp and seeds

Pericarp of ovary and perhaps anthocarp or pseudocarp

Exocarp, mesocarp, endocarp, epicarp, putamen

Dehiscence of fruits: loculicidal, marginicidal, septicidal, circumscissile, partial

Valves

Rupturing fruits

Dehiscent fruits

Capsule, legume, cochlea, loment, follicle, silicle, pyxis

Indehiscent fruits, dry and fleshy

Dry indehiscent fruits, mostly one-seeded

Provisions for distribution

Plume, wing, barb or hook, glutinous hairs on surface

Classification of

Samara, utricle, akene, caryopsis, silicle, division of loment, nutlet (schizocarp)

Fleshy fruits

Drupaceous fruits

drupe, druplet, pyrene, pome

Baccate fruits

Berry, hesperidium, pepo

Aggregate and simple fruits

Multiple fruits

Strobile, galbulus, syconium

Seed

Nucellus or kernel and coats

Nucellus

Embryo and endosperm

Endosperm

Forms and varieties: oily; starchy or mealy; fleshy;
corneous; osseous

Composition**Embryo**

Caulicle, node, cotyledons, plumule, mono-, di-,
polycotyledons

Axile, excentric, peripheral

Form: curved, straight, spiral, circinate, crumpled,
incumbent, accumbent

Scutellum**Seed coats**

Testa or exopleura and tegmen or endopleura

Positions and functions

Testa

Hilum, chalaza, raphe and micropyle

Markings and consistency

Aril and arillode

Strophiole and caruncle

(Classification of plants and systematic botany, chemical
and medicinal constituents of plants and proximate
principles should follow, as the school is able to find
time for further elaboration of the subject.)

**MICROSCOPICAL OR MINUTE STRUCTURE OF PLANTS: VEG-
ETABLE HISTOLOGY. Sixty hours.**

This subject is necessarily chiefly a laboratory course and
requires the use of the compound microscope. Since but few
of the students entering our schools of pharmacy have been
trained in the use of this instrument, it becomes necessary, at
the beginning of the course, to devote some time to the study
of its construction and use.

Simple microscope

Construction and use

Compound microscope

Mechanical parts, optical parts, care

Focusing

Coarse and fine adjustments

Microscopical measurements

Ocular and stage micrometers

Microscopical drawing, methods

Microscopical technique

Hand sectioning, methods of procedure

Microtomes and their use

Fixing, embedding, sectioning

Chemical reagents and tests, staining

Mounting, temporary and permanent

The cell, its structure and contents

Protoplasm, cytoplasm, nucleus, vacuoles, plastids, cell wall

Infiltrations of cell wall

Cellulose, lignin, cutin, suberin, gum

Cell contents

Organic

Starch, inulin, sugar, aleurone, oils, alkaloids,
resin, tannin, mucilage

Inorganic

Calcium oxalate, types of crystals

Calcium carbonate, cystoliths

Functions of cells

Cell as an entire plant

In bacteria (cocci, bacilli, spirilli)

In algae (pleurococci, diatoms, desmids)

In yeast

Cell as a tissue element

Protecting tissues

Epiderm, hypoderm, cork, trichomes

Assimilating tissues

Palisade, mesophyll, parenchyma

Secreting tissues

Glands, reservoirs

Conducting tissues

Sieve tubes, latex tubes, ducts, tracheids, medullary
rays

Respiratory tissues

Stomata, guard cells, lenticels

Storage tissues

Parenchyma of roots, rhizomes, tubers, bulbs

Water storage tissue

Mechanical tissues

Sclerenchyma, collenchyma, libriform, bast

Root structure

Position of growing point and exact region of elongation;
influence of gravity and moisture upon direction of
growth

Transverse, longitudinal, tangential and oblique sections
compared

Epiderm, hypoderm, cortex, cork, phellogen, collenchyma,
sclerenchyma, endodermis

Pericycle

Parenchyma, stereome

Fibrovascular bundle

Phloem

Sieve-tubes, cambium, bast fibers

Xylem

Ducts, tracheids, wood-fibers

Medullary rays

Medulla or pith

Comparison of monocotyledons and dicotyledons

Stem structure

Primary

The stele

Hadrome (xylem)

Leptome (phloem)

Endoderm, cortex, epiderm

Secondary (rarely seen in monocotyledons)

Cambium cylinder, forming open collateral bundles
with secondary xylem and phloem

Medullary rays

Transverse, oblique, radial and tangential sections
compared

Concentric bundles (convallaria)

Collateral bundles (menispermum)

Bicollateral bundles (gelsemium)

Leaf structure

General features of transverse section

Epiderm, mesophyll, vascular bundles

Epiderm

Cutinized cells

Stomata, guard cells, neighbor-cells

- Trichomes
 - Unicellular, solitary and clustered, multicellular, branched, glandular, scales
- Corky perforations
- Mesophyll
 - Palisade cells, spongy tissue
 - Form, arrangement and contents of cells
- Vascular bundles
- Special study of secretory and crystal-bearing cells
- Flower tissues
 - Diagnostic cell-structure in perigone, stamen and pistil
- Perigone
 - Epidermal cells and stomata, pigmented cells
- Stamen
 - Pollen-grain or microspore
 - Exine, intine, contents, various forms, germination, the male gametophyte and gametes
- Pistil
 - Stigmatic surface, style-tissue, ovules
- Fruit tissues
 - Pericarp and seeds
- Pericarp
 - Epicarp or exocarp, mesocarp, endocarp
- Epicarp
 - Epidermal cells, stomata, trichomes
- Mesocarp
 - Parenchyma cells
 - Arrangement, layers, forms, size, markings, contents
 - Sclerenchymatous cells
 - Arrangement, layers, forms, size, markings, contents
 - Secretory cells and contents
 - Fibrovascular bundles
- Endocarp
 - Arrangement, layers, forms, size, markings and contents of cells
- Seed tissues
 - Seed coat
 - Outer epidermis, sclerenchymatous layers, pigmental layers, parenchyma

Perisperm and endosperm

Embryo

Hypocotyl, cotyledons, epicotyl, plumule

Relations and arrangements of the parts

Types of monocotyledonous and dicotyledonous seeds,
with and without endosperm

Study of fixed oils, aleurone and starche

Plant physiology, demonstrations

Root pressure, using manometer

Photosynthesis, detecting formation of starch by use of
Ganong's leaf shield

Photosynthesis, showing qualitatively carbon dioxide
absorbed and oxygen liberated, by use of phytometer

Transpiration, by use of potometer

Geotropism of stems, contrasting growth of stems placed
horizontally in clinostat with that of those standing
horizontally in a stationary position

Geotropism of roots, similar contrast

Heliotropism, using clinostat

Evolution of carbon dioxide in growth

Region and rate of growth in stems

Effects of various constituents of soil, especially calcium,
sodium, and nitrogen, upon growth, as shown by
growing seedlings in various solutions

Etching effects of excretion of roots on marble surface,
showing its acid character.

PHYSIOLOGY AND HYGIENE. Fifty hours.

Physiology treats of the organic functions in a state of health.

It is obvious that the introduction of the amount of physiology that is essential to an understanding of the subjects listed herein will strain the possibilities of this part of the course to the utmost. This fact precludes the study of anatomy, as such, which subject is therefore presented only in connection with, and as required for, the teaching of physiology.

Introduction and General Considerations. It is scarcely practicable to prescribe the details of this portion of the subject, as each teacher is likely to have his own original method of introduction. It is wise, however, to commence with a

reference to the amoeba, describing its form and structure, and showing that it possesses all the essential properties of a living being: sensation, voluntary motion, locomotion, digestion, assimilation, disassimilation, growth and reproduction. The cohesion of similar bodies, in masses or colonies, yet each vitally independent, follows; then similar masses with the individuals composing certain parts so modified as to perform certain parts of the work, while losing other powers, which are specially delegated to other individuals of the mass. Each is thus no longer an animal, but a cell, forming a part of the animal body. This leads to the teaching of unicellular and multicellular animals, of tissues, organs and functions, anatomy and physiology and organic systems and opens the way for the main subjects of human physiology, which follow.

The Skeleton

Functions of bones: support, determining form, inclosing cavities and protecting contents

Macroscopic structure of bones: periosteum, articulating extremities, function of hollow form, elasticity, color

Microscopic structure of bone: Haversian canals, lacunae, canaliculi, nucleated cells

Hygiene of the bones: importance of food, position of body, etc.

Cartilaginous tissue: structure, texture, and color, yields chondrin

Temporary and permanent

Functions: supports, forms sockets, lessens friction, and absorbs shock

Bones of skeleton 200, head 23, trunk 52, upper limbs 64, lower limbs 62

Peculiarities of human skeleton: erect posture, curvature of spine, upper and lower limbs compared, instep and sole

Structure and mechanism of joints

Articulating extremities, cartilages, synovial membranes, ligaments

Illustrated study of important bones

Bone: organic and inorganic portions

Fiber

White non-elastic, yellow elastic, areolar

Cartilage

Hyaline, white fibrous, yellow elastic

Epithelium: squamous, columnar, modified

Serous tissue: structure and functions

Muscular tissue

Sarcolemma, musculin, complex composition of

Properties

Tonicity, contractility, irritability, how excited

Special sense of weight

Changes in, during contraction

Myosinogen and myosin

Nature of fatigue in muscle

Voluntary and involuntary, striated and non-striated
cardiac muscle

Nerve tissue

Necessity for and general functions of

Central, peripheral and conducting elements

Nerve cells and nerve fibers

The neuroglia, the neuron

Nerve cells

Structure of poles, dendrites, origin of fiber

Aggregation into centers or ganglia

Nerve fibres

Non-medullated, medullated, nodes and inter-nodes,
formation into nerves, division into fibrillae

Afferent and efferent, functions of each

Varieties of nerve endings

Nervous system

Cerebro-spinal and sympathetic divisions

Cerebro-spinal division

Its cerebral and spinal portions

Spinal portion

The cord, the nerves

Spinal nerves

Origin in cord, parts supplied by them, proof of motor and
sensory fibres which are separated in roots, the
trophic ganglion

Spinal cord

- Position, form, gross parts
- Proof of motor and sensory tracts, their location
- Proof of motor and sensory centers
- Decussation of sensory fibres, not of motor

Brain

- Principal ganglia
- Nerves

Medulla oblongata

- Location, decussation of motor fibres, the vital spot, pneumo-gastric nerves, (breaking of neck)

Cerebellum

- Location, functions

Cerebrum

- General nature and importance
- Relation of convolutions, localization of functions

Sympathetic division

- Location, general parts, plexuses, connection with cord
- Double service, active and inhibitory, control of pupil, control of arteries, control of intestines, control of glands

Blood

- Necessity
- General functions
 - Supplying nutriment and oxygen, removing waste, regulating temperature, transporting medicines, supporting mechanically, imparting color

Properties of blood

- Amount, temperature, reaction, colors, specific gravity, odor, taste

Structure of blood

- Liquid and solid portions

Solids

- Erythrocytes, leucocytes, plaques, miscellaneous granular matter

Erythrocytes or red blood corpuscles

- Properties, extent of surface
- Constituents: haemoglobin and oxyhaemoglobin
- Functions

Leucocytes or white blood corpuscles

Compared with erythrocytes as to number, size, form and structure

Action and functions

Like animalcules, independent movement and diapedesis, relation to pus cells, office as scavengers and immunizers, where produced and destroyed

Placques

Number, form, function

Blood plasma

Constituents

Circulation

Necessity, time required

Amount of mechanical labor performed by heart and auxiliary forces

Heart

Position, form, size

Pericardium, endocardium, muscular structure

Right and left hearts, septum, foramen ovale

Auricles and ventricles, auriculo-ventricular valves, ventriculo-arterial valves

The course of the blood

Diastole and systole

Nervation of heart

Respective functions of vagus, sympathetic and ganglia

Arteries

Functions

Increased calibre on division

The three walls and characters of each

Their changes in aneurism and on becoming smaller; special study of smallest

Arterioles

Vasomotor changes, blood pressure

Capillaries

Origin in arterioles

Structure and properties

Osmosis or dialysis

How affected by vasomotor changes

Veins

- Origin in capillaries

- Structure compared with that of arteries

- Presence of valves

- Capacity compared with that of arteries, causes of blood flow, hemorrhage compared with that from arteries

Respiration

- Necessity and objects

- Changes in blood and resulting color

- Percentages of oxygen and carbon dioxide interchanged

- Effects on temperature

- Inhalation of medicines and poisons

- Cutaneous respiration, effects of water supply, proper way to breathe, importance of health of nares

Mechanism of inspiration

- Rib movements, diaphragm movements, pleura and pleural space and atmospheric pressure, action partly voluntary and partly automatic, ordinary and forced inspiration

Mechanism of expiration

- Weight of chest wall, relaxation of diaphragm and elasticity of abdominal wall, elasticity of air vesicles

- A passive process

- Forced expiration and muscles of

Portions of air

- Complementary, tidal, reserved, and residual

Course of air to and from lungs

- Nares, anterior and posterior, pharynx, larynx, glottis and epiglottis, rima glottidis, tracheae, bronchi, air vesicles and mixing of air in them

Relation of blood to air in lungs

- Capillaries, osmosis

Cause of respiratory movements

Digestion

- Necessity for nutrition; nutrients and their presence in foods, digestion defined, assimilation defined

Nutrients classified

- Organic and inorganic

Inorganic enumerated and explained

- Principal foods containing them

Organic nutrients

- Similarity of animal and vegetable series

- Ultimately from plants and produced by chlorophyll acting on sun's energy

- Nitrogenized and non-nitrogenized

Nitrogenized nutrients

- Animal

 - Albumin, casein, muscudin, fibrin, gelatin

 - Foods containing them

- Vegetable

 - Albumin, gluten, legumin

 - Digestion by proteolytic enzymes

Non-nitrogenized nutrients

- Carbonaceous

 - Carbohydrates and hydrocarbons

Carbohydrates

- Sugars, starches, inulin and cellulose

- Digested by amylolytic enzymes

- Sugars compared as to value and wholesomeness

Fats and oils, glycerin

- Emulsification and saponification

Storage of nitrogenized and non-nitrogenized products compared

Excitation of digestive functions

- By smell, taste, and sight of food

Digestive processes, mechanical and chemical

- By mouth

 - Origin of saliva; nature of glands, secretory and excretory

 - The salivary glands named and described

 - Nature and functions of saliva, ptyalin

 - Exciting causes of salivary flow, absorption from mouth

 - The teeth, temporary and permanent, their care, importance of mastication

Deglutition, voluntary and involuntary parts

Digestive organs of abdomen

- Peritoneum, its position and functions

Stomach

- Position, form, cardiac and pyloric openings, coats

Mucous coat

Its loose attachment, velvety and pitted surface, mucous glands, peptic glands, alkaline coating at rest, acid secretion, causes exciting secretion, (collection for examination)

Gastric juice

Constituents

Physiology of acids, pepsin and rennin

Action of gastric juice

On starch, fat, glucose, cane sugar, egg albumin, animal fibrin, casein, lean and fat meat and milk

Inability to reach nutrients in plant cells, muscular movement and circuit of food in stomach, separation of stomach into two pouches and work of each, closing and opening of orifices

Chyme — its transfer to intestine

Absorption from stomach

Nervation of stomach, physiology of nerve elements

Intestines

Dimensions and location, coats, muscles and peristaltic action

Small and large intestine

General functions of each

Ileocaecal valve, vermiform appendix

Small intestine

Three divisions, general functions of each

Duodenum

Location and size

Connections with liver and pancreas

Three secretions from its mucous membrane

Ordinary mucous glands, intestinal follicles

Pancreas

Location, size, form, structure, openings, similarity to salivary glands

Pancreas juice, composition

Trypsin, amyllopsin, steapsin, and nature and functions of each

Causes exciting flow of pancreas juice

Liver

Position, form, size, general structure

The liver as a digestive organ

Bile

Its course to intestine, bile duct and bladder, digestive functions of the bile

Completion of digestion in small intestine

The chyle, its movement through intestine

Absorption

Villi, capillaries, lacteals

The liver as an excretory gland

Origin and course of portal vein and hepatic artery

Liver capillaries and cells, origin of bile ducts

Composition of blood in portal vein, hepatic artery and hepatic vein compared

The liver as a sugar maker, glycogen

Composition of bile, origin of excretory products

Lymphatic system

Lymph spaces and capillaries

Lymph ducts, their valves, nodes and plexuses

Thoracic ducts

Lymph

Origin and amount, composition, corpuscles

Kidneys

Position, form, capsule, lobes, pyramids, cortex, columns

Straight and convoluted tubes, Malpighian bulbs

Capillaries about tubes and in bulbs

Excretion into tubes

Transudation into bulbs

Effects of general and local changes of blood pressure

Properties and composition of urine

Nervation of kidney, causes of secretion

Vicarious excretion by skin, lungs, bowels and stomach

Passage through ureter to bladder

Suppression and retention

Origin of excretory constituents of urine

Nutritive constituents abnormal

Adrenal glands

Their secretion and its properties and functions

Thyroid glands

Their secretion and its properties and functions

Skin

- Amount of surface
- Anatomical and physiological relations to mucous membranes
- General functions
- Complex structure, epidermis and cutis vera
- Reticulate and papillary layers
- Reticulate layer, its tissues
- Papillary layer, its tissues, nerve endings, blood supply, lymphatics
- Sebaceous glands
- Sweat glands and ducts
- Epidermis
 - Corneous and pigmented layers, pigment cells
 - Hair and nail follicles
 - Nutrition of hair and nails
 - Corneous layer, functions protective
- Perspiration
 - Amount, composition, normal and abnormal
 - Glandular nerve supply, conditions exciting perspiration.
- The special senses. Sight, hearing, voice, taste, smell
- Sense of sight
 - The eye-ball
 - Situation, shape, size, coats (1) the outer coat, sclerotic membrane and cornea (2) the middle coat, choroid membrane terminating in the ciliary processes, iris and pupil (3) the inner coat, consisting of retina composed of ten coats
 - Action of mydriatic and myotic drugs upon the pupil
- Nervation of the eye
- Refracting media consisting of crystalline lens, aqueous humor, and vitreous humor
- Necessity for "accommodation"
- Myopia or shortsightedness relieved by concave glasses
- Hypermetropia or long-sightedness and presbyopia relieved by convex glasses
- Astigmatism relieved by specially ground glasses
- Accessory structure of eye
 - Muscles, lachrymal glands ducts and secretion
 - Hygiene of the eyes

Sense of hearing

The outer ear

Pinna, its structure and functions

Auditory canal, ear-drum, ceruminous glands and hairs

The middle ear or tympanum, its position

Eustachian tube, its functions

The inner ear or labyrinth

Vestibule, cochlea, membranous canals

Distribution of auditory nerve, reception of sound

Hygiene of the ears

The voice

The larynx, its location

Thyroid, cricoid and arytenoid cartilages

The glottis, its functions

The vocal cords, their structure and functions

Causes of quality of voice

The sense of taste defined

The tongue, location and functions of its taste nerve endings

Conditions for exciting taste

Subdivisions of taste located in tongue

Relations between taste and smell

Education of taste

The sense of smell

The organ of smell, nasal cavities, turbinated bones, nasal hairs

Nerves of smell and their endings

Conditions for exciting smell

Functions of smell

INTRODUCTION TO MATERIA MEDICA. Classification of Medicines. Ten hours.

In this introduction the general facts and principles of materia medica are brought out and instruction given to cover the requirements of examination for licensing pharmacists. The whole spirit of professional pharmacy, its ultimate success and its moral and professional relation with medicine, render the practice of counter-prescribing objectionable. There has been much instruction given in schools

of pharmacy which might tend to encourage students in the idea that they were being prepared for this unauthorized work after entering on the pursuit of their calling. In the *Syllabus*, the attitude toward this question should be very definite. We therefore draw the line in therapeutics between its principles and its practice, admitting the former to the extent of giving the student general ideas of the fundamental principles of the subject but excluding the latter. This procedure allows to therapy-dynamics a very small amount of time as compared with pharmaco-dynamics.

To enunciate this principle in concrete form, the therapeutic teaching is limited to a classification of medicines on the basis of their action, defining and explaining the different classes and then, in the discussion of the drugs, merely stating the class to which they belong, respectively, with perhaps a few words as to the position of each in its class. This general instruction is best given in connection with that relating to the bodily functions and as a part of the physiology course. It will then be found of great advantage to review these explanations and definitions, either in lecture or recitation, at the beginning of the materia medica course of the second year.

Antiseptics

General, urinary, intestinal

Disinfectants

Germicides

Antizymotics

Parasiticides

Sera and vaccines

Counterirritants, rubefacients (mustard), vesicants (cantharis), pustulants (croton oil), caustics or escharotics (silver nitrate)

Emollients and demulcents

Astringents and haemostatics (tannin and iron chloride)

Cathartics, therapeutic classification

Laxatives or aperients, purgatives, drastics

Chologogues (salicylates)

Diuretics

Direct (buchu)

Indirect (digitalis)

Digestive ferments, amylolytic and proteolytic

Stomachics, simple bitters (gentian), aromatics (peppermint),
aromatic bitters (bitter orange peel), astringent bitters
(cinchona)

Effect of acids and alkalies

Carminatives (anise)

Emetics

Central acting (apomorphine)

Direct acting (mustard)

Anthelmintics, taenicides (male fern), lumbricides (santonin),
ascaricides (quassia), anchylostoma (thymol), uncinaria
(oil of chenopodium)

Alteratives (potassium iodide)

Antipyretics (acetanilide, quinine)

Antisyphilitics (mercury, salvarsan)

Diaphoretics (pilocarpus)

Expectorants, nauseant (ipecac), indifferent (iodides), stimu-
lant (ammonium carbonate)

Hysteric sedatives (valerian)

Drugs acting on the central nervous system

(a) Higher centers, stimulant (caffeine), depressant
(bromides)

(b) Medullary centers, respiratory, vagus, vasomotor,
vomiting.

(c) Cardiac, stimulant (strychnine), depressant (bro-
mides)

Drugs acting on the peripheral nervous mechanism

(a) Autonomic, stimulant (physostigmine), depressant
(atropine)

(b) Sympathetic (epinephrine)

Drugs acting on muscle

(a) Striated muscle (veratrine)

(b) Smooth muscle (digitalis)

(c) Cardiac muscle (digitalis)

(d) Uterine muscle (ergot)

Anaesthetics, general (ether), local (cocaine)

Analgesics (diacetylsalicylic acid)

Hypnotics or somnifacients (sulphonmethanum)

Narcotics (morphine)

Blood medicines, to increase alkalinity (sodium bicarbonate),
haematinics (iron)

Cardiants

Stimulants (digitalis), depressants (aconite)

POSOLOGY. Fifteen hours.

The most important object of this short course is to familiarize the student with the dosage of potent drugs, that he may be able to avoid danger of such accidents by poisoning as are incident to the duties of the pharmacist.

The following general facts must be kept in mind:

The medicinal dose of a substance varies widely according to the disease for which it is given, the person to whom it is administered and his condition at the time, his age, weight, habits, temperament, idiosyncrasy and many other factors. For these reasons the Pharmacopœia gives the average medicinal dose for an adult. These average doses should be learned, but it should be remembered that the average doses can often be very greatly exceeded, even for medicinal purposes and that in other cases much smaller doses properly may be prescribed.

The poisonous dose varies to an even greater extent. Of a certain poison, 3 grains may kill in some cases, while in others 25 times the amount may be taken and recovery follow. In studying a poison, therefore, one should learn the smallest dose that has ever been known to cause death and the largest amount that recovery has followed but such study is beyond the present course. The object of this course is to learn what doses are to be regarded as dangerous or injurious and to be treated with caution. In most cases it is advisable to look with suspicion upon the amount of a poisonous substance two or three times in excess of the average medicinal dose. The more highly poisonous the substance, the narrower the margin, usually, between the medicinal and the poisonous dose.

SECOND YEAR

The instruction in this department during the second year includes the general principles of materia medica reviewed fifteen hours, posology and toxicology twenty-five hours, pharmacognosy ninety hours, pharmaco- and therapy-dynamics seventy hours.

MATERIA MEDICA, PHARMACO- AND THERAPY-DYNAMICS.
Eighty-five hours.

Pharmaco-dynamics treats of the action of medicines on healthy organs. Therapy-dynamics treats of the action of medicines on diseased organs.

In the following list, the drugs are enumerated in their botanical sequence, by which means the systematic relations of medicinal plants are displayed. Some teachers prefer to group the drugs, in their lecture course, in accordance with a therapeutical classification; it is to be understood that each is free to exercise his own choice in this matter.

Order of topics. General remarks on economics of families of plants, especially as to the general nature of their medicinal constituents and their medicinal properties.

Enumeration of drugs pertaining to family

Study of each drug

Official or unofficial

Official titles, synonyms, names liable to be confused

Definition explained as to meaning and reasons therefor

Principal cautions regarding quality, etc., including standardization, if employed

Character of plant, range, habit, collection or cultivation and preparation of drug

Constituents. Physiologic and therapeutic properties

Uses and preparations

Thallophytes

Algae (green, brown, and red), laminaria, fucus, agar-agar, chondrus, helminthochorton

Fungi (phycomycetes, eumycetes, schizomycetes, basidiomycetes); yeast, keffir, ergot, agaric, aspergillus

Lichenes

Pulmonaria, cetraria

Byrophytes

Musci

Polytrichum

Pteridophytes

Filices

Aspidium, adiantum

- Equisetaceæ
 - Equisetum
- Lycopodiaceæ
 - Lycopodium
- Spermophytes
 - Gymnosperms
 - Pinaceæ
 - Juniperus, sabina, thuja, pinus, terebinthina, terebene, resina, related turpentine and resins, pix burgundica, pix liquida, pix navalis, oleum cadinum
 - Angiosperms
 - Monocotyledons
 - Gramineæ
 - Triticum, zea, amyllum, maltum, diastase, saccharum
 - Palmæ. Areca, sabal, oleum cocois, oleum palmæ, resina draconis
 - Araceæ. Calamus, arum, dracontium
 - Liliaceæ (including subfamilies). Sarsaparilla, aloe, allium, scilla, convallaria, colchicum, veratrum, sabadilla, veratrina, helonias, trillium
 - Dioscoriaceæ. Dioscorea
 - Iridaceæ. Crocus, iris, iris versicolor
 - Zingiberaceæ. Cardamom, zingiber, curcuma, galangal, zedoary
 - Orchidaceæ. Vanilla, salep, cypripedium
- Dicotyledons
 - Piperaceæ. Cubeba, piper nigrum and piper album, matico, kava
 - Salicaceæ. Salix and salicinum, balsam poplar buds
 - Betulaceæ. Oleum betulæ, birch-wood tar and its products, acidum salicylicum
 - Fagaceæ. Creosotum and its derivatives, quercus, galla, acidum gallicum, acidum tannicum, pyrogallol, castanea
 - Urticaceæ. Ulmus, humulus, lupulinum, cannabis, ficus
 - Santalaceæ. Oleum santali
 - Aristolochiaceæ. Serpentaria, asarum
 - Polygonaceæ. Rheum, rumex

- Chenopodiaceæ. Oleum chenopodii
Phytolaccaceæ. Phytolacca
Magnoliaceæ. Drimys, illicium and its oil
Myristicaceæ. Myristica, macis
Ranunculaceæ. Pulsatilla, adonis, hydrastis, staphisagria, delphinium, aconitum, cimicifuga, hepatica, helleborus, coptis
Berberidaceæ. Berberis, caulophyllum, podophyllum
Menispermaceæ. Calumba, menispermum, pareira, cocculus indicus, and picrotoxinum
Monimiaceæ. Boldus
Lauraceæ. Cinnamomum zeylanicum, cinnamomum saigonum, cinnamomum cassia, camphora, sassafras, sassafras medulla, coto and paracoto, laurus
Papaveraceæ. Opium and its products, papaveris fructus, papaveris semen, oleum papaveris seminis, sanguinaria, chelidonium, corydalis
Cruciferae. Sinapis alba, sinapis nigra
Droseraceæ. Drosera
Hamamelidaceæ. Hamamelis, styrax
Rosaceæ (including subfamilies). Rosa gallica, oleum rosæ, prunus virginiana, prunum, amygdala amara, amygdala dulcis, acidum hydrocyanicum, quillaja, rubus, cusso
Leguminosæ (including subfamilies). Scoparius, baptisia, galega, tragacantha, acacia, glycyrrhiza, melilotus, trifolium, physostigma, chrysarobinum, kino, santalum rubrum, piscidia, balsamum toltutanum, balsamum peruvianum, abrus, hæmatoxylon, cassia fistula, senna, tamarindus, copaiba
Geraniaceæ. Geranium
Erthroxylaceæ. Coca
Linaceæ. Linum
Zygophyllaceæ. Guaiacum
Rutaceæ. Buchu, xanthoxylum, pilocarpus, the citrus group
Simarubaceæ. Simaruba, quassia, semen cedronis
Burseraceæ. Myrrha, olibanum, elemi
Euphorbiaceæ. Cascarilla, oleum ricini, oleum tigllii, euphorbium, euphorbia pululifera, kamala, stillingia, elastica
Polygalaceæ. Senega
Krameriaceæ. Krameria

Meliaceæ. Cocillana

Anacardiaceæ. Rhus glabra, rhus toxicodendron (toxicology specially treated), mastiche, pistacia

Celastraceæ. Euonymus

Sapindaceæ. Guarana

Rhamnaceæ. Frangula, cascara sagrada, rhamnus cathartica, ceanothus

Malvaceæ. Althæa, gossypii cortex, gossypium purificatum, pyroxylinum, collodium, oleum gossypii seminis

Sterculiaceæ. Cacao, oleum theobromatis, cola

Guttiferæ. Cambogia

Cistaceæ. Helianthemum

Canellaceæ. Canella alba

Passifloraceæ. Passiflora

Caricaceæ. Papaw juice

Cactaceæ. Cactus grandiflorus

Thymelæaceæ. Mezereum

Punicaceæ. Granatum

Myrtaceæ. Eucalyptus, oleum cajuputi, oleum myrciæ, caryophyllus, pimenta, chequen

Araliaceæ. Aralia

Umbelliferæ. Conium, carum, anisum, fœniculum, sumbul, asafoetida, ammoniacum, coriandrum, galbanum, ajowan, apium, petroselinum, angelica, levisticum, cuminum, anethum

Cornaceæ. Cornus

Ericaceæ. Uva ursi, chimaphila, gaultheria

Sapotaceæ. Chicle, gutta percha

Styraceæ. Benzoinum

Oleaceæ. Manna, oleum olivæ, fraxinus

Loganiaceæ. Nux vomica, ignatia, gelsemium, spigelia

Gentianaceæ. Gentiana, chirata, centaurea

Apocynaceæ. Apocynum, strophanthus, aspidosperma

Asclepiadaceæ. Asclepias, condurango

Convolvulaceæ. Jalapa, scammoniæ radix

Hydrophyllaceæ. Eriodictyon

Verbenaceæ. Verbena

Labiata. Lavandula, mentha piperita, mentha viridis, thymus, serpyllum, hedeoma, marrubium, salvia, rosmarinus, scutellaria, origanum, marjorana, melissa

Solanaceæ

Capsicum, belladonna, scopola, hyoscyamus, stramonium,
tabacum, fabiana, dulcamara, solanum carolinense

Scrophulariaceæ. Digitalis, leptandra, verbascum

Rubiaceæ. Coffea and caffeina, gambir, ipecacuanha, cin-
chona and alkaloids

Caprifoliaceæ. Sambucus, viburnum opulus, viburnum prun-
ifolium

Valerianaceæ. Valeriana

Cucurbitaceæ. Colocynthis, pepo, elaterium, bryonia

Campanulaceæ. Lobelia

Compositæ. Calendula, carthamus, anthemis, senecio, mat-
ricaria, tanacetum, absinthium, eupatorium, lappa, tarax-
acum, cichorium, santonica, inula, pyrethrum, echinacea,
arnica, lactucarium, grindelia

Animal drugs. Antitoxins and vaccines, thyroid extract,
adrenalin, pepsinum, pancreatinum, adeps, adeps lanæ,
sebum, cetaceum, oleum morrhuæ, ichthyocollo, moschus,
fel bovis, saccharum lactis, acidum lacticum, coccus,
cantharis, mylabris, mel, cera

Halogens. Chlorine, bromine, iodine

Chlorine preparations

Bromine and bromides

Iodine and iodides and their preparations

Oxygen, water, distilled water, hydrogen dioxide

Sulphur: sublimed, precipitated, washed

Sulphurated lime, sulphur iodide, carbon disulphide

Nitrogen, phosphorus, arsenic, antimony

Phosphorus and its preparations

Hypophosphorous acid, hypophosphites

Arsenic, arsenic trioxide, preparations of

Sodium arsenate, preparations of. Arsenous iodide

Antimony. Antimony and potassium tartrate, preparations
of

Carbon. Animal charcoal, wood charcoal

Acids, mineral acids, vegetable acids

Alkali metals: potassium, sodium, lithium, ammonium

Potassium: hydroxide, carbonate, bicarbonate, acetate,
citrate, sulphate, bitartrate, chlorate, ferrocyanide,
cyanide, iodide, bromide, nitrate

Sodium: hydroxide, monohydrated carbonate, bicarbonate, sulphate, citrate, chloride, sulphite, bisulphite, thiosulphate, acetate, phosphate pyrophosphate, salicylate, benzoate, borate, bromide, iodide

Lithium: bromide, carbonate, citrate

Ammonium: stronger ammonia water, ammonia water, carbonate, chloride, acetate, salicylate, benzoate, bromide, iodide, valerate

Alkaline earth metals: calcium, strontium, barium

Calcium: lime, prepared chalk and preparations, precipitated carbonate, chloride, dried sulphate, phosphate, bromide, lactate, hypophosphite, chlorinated lime

Strontium lactate

Barium dioxide

Magnesium, zinc, mercury

Magnesium: sulphate, carbonate, oxide, talcum

Zinc: chloride, sulphate, precipitated carbonate, oxide, acetate, stearate, valerate

Preparations of metallic mercury

Red mercuric oxide, yellow mercuric oxide, mercuric chloride, mercurous chloride, mercuric iodide, mercurous iodide, solution mercuric nitrate, ointment of mercuric nitrate, ammoniated mercury, mercuric subsulphate

Copper, silver, gold

Copper: sulphate, nitrate, oxide, cyanide

Silver nitrate

Gold and sodium chloride

Earth metals. Aluminum, cerium

Aluminum, alum, aluminum hydroxide, sulphate, kaolin

Cerium, cerium oxalate

Lead, bismuth, chromium, manganese

Lead: oxide, acetate, nitrate, iodide, carbonate

Bismuth: subcarbonate, subnitrate, citrate, subgallate, subsalicylate

Chromium: trioxide, dichromates

Manganese: precipitated dioxide, sulphate, permanganate

Iron: reduced iron, ferrous salts, ferric salts, salts with vegetable acids

Petrolatum, white petrolatum, liquid petrolatum, benzin, paraffin

Alcohols: alcohol, denatured alcohol, wines, wood alcohol

Ethers: ether, acetic ether, amyl nitrite, spirit of nitroglycerin, sodium nitrite, spirit of nitrous ether, ethyl carbamate, ethyl chloride, ethyl bromide, methyl chloride

Aldehydes, chloroform and related compounds: chloroform, chloral hydrate, trichloroacetic acid, paraldehyde, bromoform, iodoform, acetone, chloralformamide, sulphonmethane, sulphonethylmethane, hexamethylenamine, methylthionine chloride, solution of formaldehyde

Anilines: acetanilide, antipyrine, acetphenetidine

Phenols: phenol, sodium phenolsulphonate, zinc phenolsulphonate, cresol, resorcinol, thymol iodide, iodol

Naphthols: naphthalene, betanaphthol

TOXICOLOGY. Twenty-five hours.

Toxicology treats of poisons, their recognition, effects and antidotes. The physiological classes of poisons conform very closely with the physiological classes of medicines and may be taught at the same time, as some prefer. But because the direction of poisoning by a drug is often exactly opposite to that of the intended medicinal effect, it seems better to present an outline of the principles of poisoning and a general classification of poisons, with the characteristic effects of each class, at the beginning of the course and then the toxicology of the individual drug in connection with its materia medica. A very great amount of time in repetition, which is necessitated by any other arrangement, is thus saved.

Poison defined. Local and systemic poisoning

Local poisoning

Corrosive

Forms of death

Inflammatory

Order and progress of effects

Irritation, inflammation, pustulation, abcess, ulceration, gangrene, blood poisoning

Shock

Nature and effects

Classification of local poisons

Corrosive

Acids, organic and inorganic

Principal inorganic, principal organic

Characteristic action

Phenol group

Characteristic action

Alkalies

Enumerate chief

Characteristic action

Inflammatory

Preceding classes when diluted

Acids

Alkalies and salts

Metallic salts

Phosphorus

Halogens

Irritant gases

Specific vegetable irritants

Specific animal irritants

Treatment of corrosive and irritant poisons

Chemical antidotes. Abortives

Guard against injury from violent reaction,
also from excessive amount

Stomach tube and emetics

Purgatives

Conditions determining their use

Demulcents and sedatives

Mechanical and medicinal

Stimulation and support

Systemic poisoning

Modes of occurrence

Modes of entering system

General nature of effects

Primary and secondary, exhaustion

Classification of systemic poisons

General motor paralyzants

Of voluntary and involuntary systems

Special motor paralyzants

Respiratory

Circulatory, primary and secondary

General motor irritants (convulsants)

Acute and chronic

Death from convulsions

Death from exhaustion

Special motor irritants

Acute and chronic

(Of circulation)

(Of respiration)

Abortifacients

Sensory irritants

During circulation

During excretion

Sensory paralyzants

Somnifacients

Anæsthetics

Cerebral stimulants

Equable (as caffeine)

Non-equable or narcotic

(Death from acts to self or others under influence)

Treatment of systemic poisoning

Depends upon stage. The three stages and their treatment

Poisons to nutrition: phosphorus, etc.

Poisons destructive to blood structure or functions

Poisonous gases

PHARMACOGNOSY. Ninety hours.

Pharmacognosy is the art of identifying, selecting, and valuing drugs. Its practice involves both macroscopic and microscopic examinations which are based directly upon the practice secured during the first year in these respective methods. Some teachers will prefer to perform both kinds of work during the same laboratory exercise, while others will assign them to different hours. The instruction concerning each drug should include its identification, variety, quality — depending upon its season of collection and manner of preparation and preservation — its packing, storing and freshness, freedom from impurity and the study of the impurities to which it is specially liable.

Economic conditions should be studied so far as to instruct the pharmacist in his commercial operations with the drugs.

Roots. Sarsaparilla (Mexican, Jamaican and Honduras), senega, gentian, dandelion, chicory, pellitory (German and Roman), echinacea, elecampane, burdock, dogbane, stillingia, aralia, angelica (European and American), parsley, sumbul, pleurisy root, pokeroot, marshmallow, belladonna, baptisia, bryony, calumba, curly and yellow dock, rhubarb, licorice (Spanish and Russian), hydrangea, kava, ipecac (Rio and Cartagena), gelsemium, pareira, krameria.

Rhizomes. Male fern, ginger (Jamaican, East Indian, and African), turmeric (Madras and Java), calamus (peeled and crude), triticum, veratrum (white and green), alettris, helonias, trillium, blue flag, lady's slipper, lily-of-the-valley, dioscorea, bloodroot, geranium, mandrake, valerian, arnica root, Virginia and Canada snakeroot, pink-root, golden-seal, blue cohosh, cimicifuga, hellebore, leptandra, moonseed, barberry, gold-thread.

Tubers and bulbs. Jalap, aconite, colchicum, squill, corydalis.

Woods. Quassia (Jamaican and Surinam), logwood, sandalwood, red saunders, guaiac.

Barks. Cinchona (red, yellow, and pale), cascarilla, tulip tree, wild cherry, blackhaw (root and stem), cramp bark, witch hazel, willow, barberry, bayberry, white oak, blackberry, pomegranate, simaruba, condurango, buckthorn, cascara sagrada, quebracho, paracoto, prickly ash, mezereum, cotton root, soap bark, pine, elm, sassafras, cinnamon (Ceylon, Saigon and Cassia), canella alba.

Herbs and flowers. Levant wormseed, cloves, poplar, lavender, elderberry, mullein, calendula, safflower, arnica, chamomile (Roman and German), insect flowers (Persian and Dalmatian), cusso, lily-of-the-valley, Irish moss, Iceland moss, cannabis, clover, pulsatilla, adonis, broom, galega, melilot, eupatorium, grindelia, tansy, wormwood, mugwort, lobelia, peppermint, spearmint, marjoram, thyme, pennyroyal, horehound, catnep, skullcap, chiretta, centaury, helianthus, euphorbia pilulifera, drosera, verbena, crocus, zea.

Leaves and leaflets. Rosemary, boldo, jaborandi, bay, eucalyptus, bearberry, senna (Alexandria and India), coca

(Bolivian and Truxillo) belladonna, stramonium, henbane, digitalis, matico, sage, witch hazel, colts-foot, chestnut, yerba santa, damiana, chimaphila, marshmallow, wintergreen, buchu (long and short), aconite, liverwort, menyanthes, conium.

Fruits. Juniper, hops, black and white pepper, cubeb, allspice, buckthorn, fish-berries, sumac berries, horse-nettle, capsicum, poppy capsules, colocynth, cassia fistula, American wormseed, prickly ash, star anise, cardamom, orange peel, lemon peel, mace, coriander, hemlock, anise, parsley, celery, angelica, fennel (Roman and German), cumin, dill, saw palmetto.

Seeds. Calabar bean, sweet and bitter almond, pumpkin, tonka, cacao, cola, fenugreek, white and black mustard, flaxseed, nux vomica, larkspur, stavesacre, castor, croton, stramonium, henbane, poppy (white and blue), strophanthus, sabadilla, colchicum, cardamom, areca, lobelia, guarana.

Medulla. Sassafras pith

Sclerotium. Ergot

Trichomes. Gossypium, lupulin, kamala

Spores. Lycopodium

Cell contents. Amylum

Excrescences. Galls

Plant juices. Lactucarium, aloe, kino, eucalyptus

Gums. Acacia, tragacanth

Gum-resins. Gamboge, ammoniac, myrrh, asafetida, elemi, scammony

Oleo-resins and resins. Turpentine, mastic, rosin, sandarac, guaiac, copaiba

Balsams. Benzoin, dragon's blood, balsam of Peru, balsam of tolu, styrax

Extracts. Catechu, gambir, licorice

Animal drugs

Insects. Cantharis, mylabris, coccus

Fish. Ichthyocolla, oleum morrhuae

Sugars. Mel, saccharum lactis

BRANCH II—CHEMISTRY

Two hundred hours first year, two hundred hours second year, total of four hundred hours. Chemistry is that branch of science which treats of the specific properties and the composition of substances, and phenomena accompanying changes in composition.

FIRST YEAR

The instruction in the first year includes elementary physics twenty-five hours, general inorganic chemistry seventy-five hours, qualitative analysis fifty hours, and manufacturing chemistry fifty hours.

ELEMENTARY PHYSICS. Twenty-five hours.

Physics is that branch of science which treats of the general properties of matter and the effects of energy upon matter.

Common illustrations of physical laws and their application to pharmacy

Volume, mass, weight, density

States of matter, kinetic theory

Properties of matter, tenacity, surface tension, capillarity

General laws of gravitation

Center of gravity

Mechanics, advantage, efficiency

Levers, pulleys, pendulum

Construction of scales, balances and weights

Molecular attraction

Cohesion

Adhesion

Diffusion, osmosis, dialysis

Hydrostatics

Gravity pressure

Varying depth, density of liquids, direction, shape of container

Specific gravity

of solids

of liquids

Specific volume

Pneumatics

- Gas pressure due to gravity, molecular motion
- Atmospheric pressure, evidences of, how measured
- Boyle's law
- Pumps and siphon

Heat

- Effects of heat
 - Expansion of solids, liquids and gases
 - Change of state — fusion, vaporization
 - Latent heat
 - Calorimetry, thermal units
 - Temperature
 - Absolute zero, absolute temperature

Measurement of temperature

- Thermometers
- Pyrometers
- Boiling, melting and congealing points
- Ignition, fusion
- Transmission or diffusion of heat, conduction, convection, radiation

Light

- Luminous, illuminated, transparent, translucent and opaque bodies
- Reflection, law, mirrors
- Refraction, law, lenses, instruments
- Dispersion, spectra, spectroscope
- Double refraction, polarization, polariscope

Electricity

- Static
- Current generation
- Electric cells
- Induced electricity

Magnetism

- Induction coils

Electrical measurements, units of measure

Effects of electricity

- Luminous, x -rays, radiographs
- Thermal
- Physiological, cataphoresis
- Chemical
 - Ionization, electrolysis

GENERAL INORGANIC CHEMISTRY. Seventy-five hours.

General inorganic chemistry treats of the principles of chemistry and of the elements and their compounds, excepting the compounds of carbon, of which only certain simple compounds are included.

This subject should give a comprehensive and connected view of the more important facts and laws of elementary chemistry, including the study of the official salts of the metals and other official inorganic compounds. Throughout the course especial attention should be paid to the application of chemical facts and principles to pharmaceutical processes. The course should be based on the study of at least one standard text-book.

The underlying truths or general principles pertaining to chemistry found in any given lesson should be brought out, whether time permits of a discussion of the entire contents of the lesson or not. Chemical notation, nomenclature and equation writing should be thoroughly taught and recent views of the ionic and other theories should be included.

A detailed description should be given of each important substance studied, including its occurrence, sources, methods of manufacture, properties, official requirements and tests for identity and purity. Commercial methods of manufacture should be described as fully as time permits, and visits should be made as often as possible to chemical industries of interest to pharmacists. The instruction should be co-ordinated with the practical work of manufacturing chemistry and should be so adjusted that the lectures shall precede by a short interval the practical work in the laboratory.

The order in which the elements are taken up in the following arrangement is modified from the periodic system to meet pedagogic needs, and it is often advisable to change this order to agree with the arrangement of the text-book used. The compounds mentioned under each element are for special study. Many others may very properly be studied in the course. Besides the important elements included in this outline, rarer elements should be considered as time permits.

Preliminary theory

Matter

Physical changes

Chemical changes

Conservation of matter and energy

Kinds of chemical changes

Definition of chemistry

Structure of matter: masses, molecules, atoms

Composition of matter: mixtures, compounds, elements

Valence

Symbols, formulas, equations

Other topics of theoretical chemistry are best taken up at appropriate times as the descriptive matter is studied.

Hydrogen: occurrence, preparation, electrolysis of water, displacement from water by metals, displacement from acids by metals, physical and chemical properties, uses

Chlorine: occurrence, preparation, physical and chemical properties, uses

Hydrochloric acid: formula, preparation, composition, properties, uses, chlorides

Bromine: occurrence, preparation, properties, uses, hydrobromic acid, bromides

Iodine: occurrence, preparation, properties, uses, hydriodic acid, iodides

Fluorine: occurrence, properties, hydrofluoric acid

Halogen group: comparison of physical and chemical properties

Oxygen: occurrence, preparation, physical and chemical properties, uses, including its part in respiration of plants and animals

Water: occurrence, composition, properties, uses, water of crystallization, natural waters, impurities, purification

Hydrogen dioxide: preparation, properties, uses

Acids, bases, salts, nomenclature

Atomic theory: development from laws of definite and multiple proportions

Avogadro's law

Sulphur: occurrence, preparation, allotropic forms, properties, uses, commercial forms; stick, sublimed, washed, precipitated

- Hydrogen sulphide: preparation, properties, uses
Sulphur dioxide: preparation, properties, uses
Sulphur trioxide: preparation, properties, uses
Sulphuric acid: preparation, properties, illustrations of wide industrial use, sulphates
Nitrogen: occurrence, preparation, physical and chemical properties
The atmosphere: a mixture varying in composition, constituents, with uses of each, liquefaction
Ammonia: general mode of formation, preparation, properties, uses
Oxides of nitrogen, briefly considered
Nitric acid: preparation, properties, uses, aqua regia; nitrates, explosives
Phosphorus: occurrence, preparation, properties, allotropic forms, compounds, hydrogen phosphide, oxides
Acids of phosphorus: preparation, properties, uses, salts
Carbon: distribution in nature, allotropic forms, preparation of commercial forms, charcoal, coke, bone-black, lampblack, gas carbon, properties, uses
Carbon dioxide: natural formation and occurrence, preparation, properties, uses, carbonates
Carbon monoxide: preparations, properties, uses
Silicon: occurrence, silicon dioxide and the silicates
Boron: boric acids and the borates
Classification of elements. The periodic system
Potassium: occurrence, preparation, properties, compounds — bicarbonate, bromide, carbonate, chlorate, dichromate, hydroxide, hypophosphite, iodide, nitrate, permanganate, sulphate
Sodium: occurrence, preparation, properties, uses, compounds — arsenate, bicarbonate, bisulphite, borate, bromide, carbonate, chlorate, chloride, hydroxide, hypophosphite, iodide, nitrate, nitrite, phosphate, pyrophosphate, sulphate, sulphite, thiosulphate
Lithium: occurrence, compounds — bromide, carbonate
Ammonium: compounds — bromide, carbonate, chloride, hydroxide, iodide
Copper: occurrence, metallurgy, properties, uses, compounds — sulphate

- Silver: occurrence, metallurgy, properties, uses, compounds — bromide, chloride, iodide, nitrate, oxide
- Gold: occurrence, metallurgy, properties, uses, compounds — chloride
- Calcium: occurrence, compounds — oxide, bromide, carbonate, chloride, hypophosphite, hydroxide, phosphate, sulphate, sulphurated lime, chlorinated lime
- Strontium: occurrence: compounds — bromide, iodide, nitrate
- Barium: occurrence, compounds — carbonate, chloride, dioxide, hydroxide, nitrate, sulphate
- Magnesium: occurrence, preparation, properties, uses, compounds — carbonate, hydroxide, oxide, sulphate
- Zinc: occurrence, metallurgy, properties, uses, compounds — bromide, carbonate, chloride, iodide, oxide, sulphate
- Mercury: occurrence, preparation, properties, uses, compounds — corrosive chloride, mild chloride, iodides, nitrates, oxides, ammoniated mercury
- Aluminum: occurrence, metallurgy, properties, uses, compounds — alums, hydroxide, sulphate
- Tin: occurrence, metallurgy, properties, uses, compounds
- Lead: occurrence, metallurgy, properties, uses, compounds — carbonate, iodide, nitrate, oxide
- Arsenic: occurrence, properties, detection, compounds — iodide, oxide, arsenites, arsenates
- Antimony: occurrence, properties, compounds — sulphides
- Bismuth: occurrence, properties, compounds — subcarbonate, subnitrate
- Chromium: occurrence, compounds — trioxide, potassium chromate, potassium dichromate
- Manganese: occurrence, compounds — dioxide, hypophosphite, sulphate, potassium permanganate
- Iron: occurrence, metallurgy, varieties — cast, wrought, steel, reduced; properties, uses, compounds — chloride, hydroxide, hydroxide with magnesia, hypophosphite, phosphate soluble, pyrophosphate, sulphates, iron and ammonium sulphate
- Nickel: occurrence, metallurgy, properties, uses, compounds
- Cobalt: occurrence, compounds
- Platinum: occurrence, metallurgy, properties, uses, compounds

QUALITATIVE ANALYSIS. Fifty hours.

Qualitative analysis ascertains the identities of the constituents of substances.

The following outline provides for a continuation of the course in general inorganic chemistry and looks forward to the subject of general organic chemistry to be followed by quantitative analysis. Sufficient time should be given to lectures describing the action of reagents upon solutions of inorganic salts, of bases and of acids, but the outline is intended for a course in individual laboratory methods.

Individual notebooks should be insisted upon. The course should be based on the study of at least one standard text-book in order that the student may gain a comprehensive and connected view of the important facts, methods, and laws involved.

The seven classes of the metallic elements or groups

Definition of the term 'class' or 'group'

Ag, Pb, Hgⁱ,

Hgⁱⁱ, Bi, Cd, Cu

As, Sb, Sn

Fe, Al, Cr

Zn, Mn, Ni, Co

Ca, Ba, Sr, Mg

Mg, Na, K, Li, NH₄

General tests for the metallic elements and groups

Special tests for the metallic elements and groups

Analysis of known and unknown solutions containing members of the seven classes of metals or groups

Analysis of unknown solutions containing interfering acids as H₃PO₄ with Ba, Sr, Ca, Mg, so called Phosphate Chart

The marked difference in the analysis of metallic and non-metallic substances

General tests for non-metallic elements and groups

Diluted acid test, effervescence, odor, precipitate

Special tests for the non-metallic elements and groups

Carbonates, cyanides, sulphides, sulphites, thiosulphates, chromates, arsenites, arsenates, sulphates, phosphates, oxalates, tartrates, borates, silicates, fluorides,

chlorides, bromides, iodides, nitrates, chlorates, acetates, oxides, hydroxides, citrates, hypochlorites, hypophosphites.

Analysis of known and unknown solutions for acidic constituents

Analysis of unknown solutions for basic and acidic constituents

The analysis of unknown solids

(a) simple

(b) mixed

The order of procedure

Preliminary examination

Effects of heat, oxidizing and reducing flames

Deflagration

Flame tests

Methods of effecting solution

Table of solubilities

Solution in aqueous, acid or alkaline solvent

Treatment of insoluble substances

Fluxes and fusions. Treatment of fused mass

Decomposition by calcium carbonate and ammonium chloride

Fusion with acid sodium sulphate

Treatment of a pure metal or alloy

Action of nitric acid on the metals

Complete solution, incomplete solution

MANUFACTURING CHEMISTRY. Fifty hours.

Manufacturing chemistry treats of the production and purification of chemicals.

Laboratory exercises supplemented by lecture work on the manufacture of some of the chemical substances and solutions that can be manufactured in a drug store.

The following will serve as examples:

Solution, simple, involving chemical reaction

Solution of mercuric nitrate

Solution of potassium arsenite

Solution of lead subacetate

Solution of zinc chloride

Solution and oxidation

Solution of ferric chloride

Solution of ferric sulphate

Solution, Precipitation process

Diluted hydrobromic acid

Diluted hydriodic acid

Diluted hydrocyanic acid

Solution, Containing a gas

Sulphurous acid

Compound solution of chlorine

Diluted hydrobromic acid, distillation process

Double decomposition

Soft soap

Zinc stearate

Lead plaster

Direct union of the elements

Sulphur iodide

Saturation and granulation

Ammonium salicylate

Sodium salicylate

Potassium acetate

Precipitation

Bismuth citrate

Lead iodide

Silver oxide

Yellow mercurous iodide

Red mercuric iodide

Yellow mercuric oxide

Ammoniated mercury

Ferric hydroxide

SECOND YEAR

The instruction in chemistry during the second year includes general organic chemistry fifty hours, qualitative analysis twenty-five hours, manufacturing chemistry twenty-five hours, quantitative analysis fifty hours, and drug assaying fifty hours.

ORGANIC CHEMISTRY. Fifty hours.

Organic chemistry treats of the compounds of carbon.

The outline submitted here requires considerably more than the allotted time for its proper presentation but it does not seem as if the subject could be properly presented in a more abridged form.

Introduction

Historical development

Definitions

Characteristics of organic compounds

Analysis, qualitative, quantitative, ultimate, proximate

Calculation from ultimate analysis

Empirical formula

Molecular formula, molecular weight determination

Rational, constitutional, graphic formulas

Radicals in organic chemistry

Methane

Occurrence in nature, formation

Preparation, properties, uses

Substitution products

Halogen derivatives, methyl and methylene chlorides,
bromides and iodides

Chloroform, manufacture, properties, purity

Bromoform

Iodoform

Carbon tetrachloride.

Chain compounds

Marsh gas series of hydrocarbons

General considerations, isomerism, nomenclature, homologues

Unsaturated hydrocarbons

The olefins

Addition compounds

Acetylene series

Acetylene

Other series of unsaturated hydrocarbons. Isologues

Sources of hydrocarbons

Destructive distillation of organic matter

- Natural formation, coal, petroleum
- Petroleum products, illuminating oils, lubricants, benzin, petrolatum, paraffin
- Halogen derivatives of hydrocarbons other than methane, ethyl chloride, bromide, iodide
- Introduction of oxygen into hydrocarbons
 - Alcohols: general properties, atomicity, general formation
 - Methyl alcohol, manufacture, properties, detection
 - Ethyl alcohol, fermentation, malt diastase
 - Fermentation products, alcoholic liquors
 - Proof spirit, denatured alcohol
 - Alcohol, U. S. P., description, properties, detection, uses
 - Other alcohols: amylic, cetylic
 - Secondary and tertiary alcohols
 - Diatomic alcohols, glycols
 - Triatomic alcohols, glycerol
- Ethers: general methods of preparation, general properties
 - Diethyl ether, manufacture, properties, uses
 - Other ethers
- Further oxidation of hydrocarbons
 - Aldehydes: general methods of preparation, general properties
 - Formaldehyde: manufacture, properties, uses, detection, polymerism
- Acetaldehyde: aldehyde ammonia
 - Paraldehyde
 - Trichloraldehyde, chloral hydrate
 - Butyl chloral hydrate, other aldehydes
- Ketones: general properties and methods of production
 - Acetone, properties, uses, detection
- Sulphur derivatives of hydrocarbons
 - Thioalcohols or mercaptans
 - Sulphonic acids, sulphones
- Condensation products
 - Of alcohols and mercaptans with aldehydes and ketones
 - Sulphonal, trional
- Organic acids: occurrence, general properties and methods of formation
 - Formic acid
 - Acetic acid, manufacture, properties

- Acetates
- Trichloroacetic acid, acetic anhydride
- Valeric acid and valerates
- Stearic and other acids of the series
- Second series of acids, oleic acid
- Oleates, normal and official
- Polybasic acids: oxalic acid, succinic acid
- Hydroxy-acids, atomicity, basicity
 - Stereoisomerism, asymmetric carbon atom
 - Lactic acid
 - Lactates
 - Malic acid
 - Tartaric acid, tartrates, baking powders, scale salts
 - Citric acid, citrates, effervescing salts
- Esters: general characteristics and method of preparation, saponification
 - Ethyl acetate
 - Ethyl nitrite, manufacture, assay
 - Ethyl sulphates, ethereal oil
 - Amyl esters, acetate, nitrite
- Glyceryl esters: fats and oils, waxes
 - Occurrence, economic importance
 - General properties
 - Drying and non-drying oils
 - Analytical reactions, saponification number, iodine number
- Industries of the fats
 - Soap making, soluble and insoluble soaps, hard and soft soaps, official soaps
 - Stearic acid candle manufacture
 - Manufacture of artificial butter
 - Manufacture of glycerol
 - Glyceryl nitrate
 - Glycero-phosphoric acid and its salts
- Wool-fat, hydrous wool-fat
- Carbohydrates: chemical nature and classification, properties
 - Monosaccharids, dextrose, levulose
 - Disaccharids, sucrose, lactose, maltose
 - Polysaccharids, dextrans, starches, cellulose
 - Hydrolysis
 - Cellulose, nitrates, acetates

Nitrogen in organic compounds

- Derivatives of ammonia, amines, quaternary ammonium bases

- Occurrence, formation, properties

- Hexamethylenamine

- Amids, formamid, chloralformamid, ethyl carbamate

- Urea

- Amino-acids

- Uric acid, xanthine bases, caffeine, theobromine, theophylline

- Cyanogen compounds

- Cyanogen, dicyanogen, hydrocyanic acid, cyanides

- Isocyanides, tautomerism

- Cyanic acid, thiocyanates, isothiocyanates

- Ferrocyanides, ferricyanides

- Nitro compounds

Cyclic compounds: isocyclic and heterocyclic

- Aromatic hydrocarbons, general properties, source

- Benzene series, coal tar

- Benzene, toluene, xylenes, ortho, meta, and para

- Cumene

- Hydroaromatic compounds, terpenes, camphenes

Volatile oils

- General chemical properties

- Synthetic products of a similar character

- Camphor, monobromated camphor, camphoric acid

- Menthol

- Thymol, thymol iodide

Resins

- General properties

- Elastica

- Guaiac

Oleoresins

- Copaiba

- Turpentine, oil of turpentine, rosin, terebene, terpin hydrate

Gum resins

- Asafoetida

- Myrrh

Balsams

- Benzoin, tolu, Peru, styrax

Phenols, general characteristics

Phenol: preparation, properties, uses, antidotes, crude carbolic acid, cresol, commercial products

Polyatomic phenols

Diatomic phenols, resorcinol, hydroquinone

Triatomic phenols, pyrogallol, phloroglucinol

Phenol ethers, creosote, guaiacol, guaiacol carbonate

Aromatic alcohols, benzyl alcohol**Aromatic aldehydes, benzaldehyde**

Cinnamic aldehyde

Aromatic hydroxy-alcohols, aldehydes, ethers, etc., vanillin**Aromatic acids**

Benzoic acid and benzoates

Salicylic acid and salicylates, methyl salicylate, phenyl salicylate

Phthalic acid, phthalic anhydride, phenolphthalein

Gallic acid, tannic acid, tannins, vegetable astringents

Naphthalin, anthracene

Naphthol, alpha and beta

Nitrogen derivatives of aromatic hydrocarbons

Nitro compounds, nitrobenzene, trinitrophenol

Amido derivatives, aniline

Anilids, acetanilid, acetphenetidin

Diazo compounds, dyestuffs, methylene blue

Anthracene derivatives, anthraquinone, alizarin, emodin**Sulphonic acids, sodium phenolsulphonate****Saccharin****Pentacyclic compounds, pyrrol, thiophen, antipyrine**

Pyridine series, pyridine, quinoline

Alkaloids, chemical nature, general characteristics, solubilities

Alkaloidal reagents

Aconitine

Atropine, sulphate, oleate

Cocaine, hydrochloride, oleate

Codeine, phosphate, sulphate

Colchicine

Homatropine hydrobromide

Hydrastine hydrochloride

Hyoscine hydrobromide

- Hyoscyamine hydrobromide, sulphate
- Morphine, acetate, hydrochloride, sulphate, apomorphine hydrochloride
- Pelletierine tannate
- Physostigmine salicylate, sulphate
- Pilocarpine hydrochloride, nitrate
- Quinine, bisulphate, hydrobromide, hydrochloride, oleate, salicylate, sulphate
- Scopolamine hydrobromide
- Sparteine sulphate
- Strychnine, nitrate, sulphate
- Veratrine oleate
- Ptomaines and leucomaines
- Glucosides and neutral principles
 - Salicin
 - Aloin
 - Santonin
 - Chrysarobin
 - Strophanthin
- Proteins: general characteristics and classification
- Enzymes: general characteristics, solubility, mode of action

QUALITATIVE ANALYSIS. Twenty-five hours.

Continued from the first year. General description, preparation, and uses of U. S. P. reagents.

Examination of a few typical official articles for impurities:

Examples

- Acetic acid for hydrochloric acid, sulphuric acid and heavy metals
- Benzoic acid for chlorine, cinnamic acid, organic impurities
- Citric acid for tartaric and oxalic acids, calcium and iron salts
- Hydrochloric acid for bromine, iodine, arsenic, sulphurous and sulphuric acids, heavy metals
- Sulphuric acid for lead, arsenic, nitric, nitrous and hydrochloric acids
- Wool-fat for alkalies, free fatty acids, chlorides and organic impurities
- Alcohol for methyl alcohol, aldehyde, fusel oil

Ether for undue amount of alcohol, water, or aldehyde

Alum for alkali sulphate, zinc and iron

Ammonium bromide for iodide, bromates, iron and barium.

Ammonium chloride for heavy metals, sulphates, calcium, empyreumatic substances

Balsam Peru for rosin, turpentine, styrax, copaiba, fatty oils

Bismuth subgallate for gallic acid, nitrates and arsenic

Calcium chloride for iron, aluminum, phosphates, magnesium, alkalies

Copper sulphate for iron, aluminum and arsenic

Glycerin for sugar, arsenic, heavy metals

Calomel for mercuric chloride, ammoniated mercury

Iodine for cyanogen, chlorine and bromine

Olive oil for cotton seed and other seed oils

Phenol for creosote and cresol

Potassium acetate for carbonates, heavy metals, iron and arsenic

Potassium bicarbonate for limit of carbonate

Potassium permanganate for chlorides and nitrates

Lead oxide for moisture, carbonates, free lead, silicates, barium sulphate, copper and iron

Quinine sulphate for other alkaloids of cinchona and organic impurities

Sugar of milk for cane sugar and starch

Soap for animal fats, alkalinity

Borax for bicarbonates, phosphates, nitrates

Sodium thiosulphate for sulphides, caustic alkalies and carbonates

Zinc sulphate for arsenic, lead, copper, chlorides, free acid

Tincture vanilla for vanillin

Examination of fixed oils for mineral oils

Examination of volatile oils with polarizing apparatus

Tests for elements in organic compounds

Carbon, hydrogen, nitrogen, sulphur, phosphorus

Identification of alkaloids, glucosides

Atropine, cocaine, codeine, brucine, morphine, quinine, strychnine, veratrine

Identification of the more common organic bodies like starch, albumin, sugar, gelatin, pepsin, pancreatin, bile

MANUFACTURING CHEMISTRY. Twenty-five hours.

A continuation of the first year's work but a more advanced course. It includes instruction in the manufacture of the more difficult chemicals used in pharmacy.

The course should be supplemented by lectures giving the general details of the work as outlined and noting those chemicals that require special apparatus and those also which can only be successfully prepared on a large scale.

Solution and scaling

Soluble iron and quinine citrate

Soluble ferric phosphate

Precipitation

Bismuth subgallate

Precipitated manganese dioxide

Iodoform — acetone process

Extraction and crystallization

Piperine

Crystallization or granulation

Ammonium iodide

Potassium bromide

Potassium citrate

Potassium iodide

Red mercuric oxide

Sodium citrate

Terpin hydrate

Distillation

Spirit of nitrous ether

Methyl salicylate

Chloroform — alcohol and acetone process

QUANTITATIVE ANALYSIS. Fifty hours.

Quantitative analysis determines the relative amounts in which the constituents of a substance are present. Laboratory work forty hours supplemented by ten lectures on the theory of gravimetric and volumetric analysis.

Lectures

Quantitative analysis, general principles

Differentiation, gravimetric, volumetric and gasometric methods

First. Gravimetric analysis illustrating the different methods of washing, drying and weighing precipitates, also the methods followed in making separations.

Laboratory work

Estimation of water of crystallization

Sodium carbonate

Ferrous sulphate

Ash determination

Determination of iron in ferric citrate by ignition

Determination of iron in solution ferric chloride by precipitation as hydroxide

Estimation of sulphuric acid in K_2SO_4 as $BaSO_4$

Estimation of chlorine in sodium chloride as $AgCl$

Estimation of mercury in $HgCl_2$ as HgS

Estimation of zinc and of aluminum as oxides

Analysis of limestone, SiO_2 , Al_2O_3 , Fe_2O_3 , CaO , MgO , moisture and loss on ignition.

Second. Volumetric analysis. Normal and empirical volumetric solutions. Grouping and standardizing volumetric solutions, the proper selection and use of indicators. Apparatus and manipulation. Direct and residual titration.

Preparation of normal oxalic acid solution

Estimation of sodium hydroxide

Preparation of normal sodium hydroxide solution

Preparation of normal sulphuric acid solution

Estimation of sodium carbonate, phenolphthalein as indicator

Estimation of sodium carbonate, methyl orange and methyl red as indicators

Determination of strength of ammonia water, methyl orange as indicator

Titration of sulphuric, hydrochloric, nitric and acetic acids

Valuation of potassium bitartrate by ignition and titration and by direct titration

Valuation of lead subacetate solution

Control by drying and weighing the lead sulphate

Preparation of decinormal silver nitrate solution

Titration of a chloride, a bromide, an iodide

- Preparation of decinormal potassium permanganate solution
- Estimation of ferrous sulphate
- Determination of ferric iron after reduction to ferrous iron
- Valuation of hydrogen dioxide solution
- Estimation of ferrous sulphate by tenth-normal potassium dichromate solution
- Preparation of tenth-normal iodine and tenth-normal sodium thiosulphate solutions
- Valuation of tincture of ferric chloride
- Valuation of chlorinated lime
- Valuation of sodium sulphite
- Fehling's Solution
 - Determination of reducing sugars
- Iodometric estimation of ferric iron
- Estimation of arsenous acid in Fowler's solution
- Valuation of phenol
- Third. Gasometric processes to determine the strength of certain U. S. P. preparations.
 - Solution of hydrogen dioxide
 - Spirit of nitrous ether

DRUG ASSAYING. Fifty hours.

Drug assaying determines the relative amounts in which the active or valuable constituents of medicines are present.

A course of ten lectures on the theory and practice of drug assaying supplemented by forty hours of laboratory practice therein.

Full explanation should be given of the different processes used so that students may be able to carry out intelligently the laboratory work and to understand the stoichiometrical calculations. In addition to the fundamental principles, modifications of processes for different U. S. P. substances and preparations should be emphasized.

Much of the work outlined under other headings could properly be included in this section, for example: determination of moisture and ash, preparation of volumetric solutions and their use in the determination of chemicals and of the strength of preparations, gasometric assays.

Typical examples of each process

Assaying by simple separation of the valuable constituents through mechanical means, without the aid of chemicals

Mercury in mercurial ointment

Assaying digestive enzymes by their power to digest known quantities of certain substances

Pepsin, estimated by its power to digest albumen

Pancreatin estimated by its power to digest starch

Separating the active constituent by means of chemicals or test solutions and estimating the amount

Cineol in oil of cajuput

Cineol in oil of eucalyptus

Estimating the amount of active constituents by the residue, after having removed the active constituents

Eugenol in oil of cloves

Cinnamic aldehyde in oil of cinnamon

Fixed oils and fats

Determination of acidity, saponification, and iodine figures

Use of polariscope and of refractometer

Alkaloidal assay by immiscible solvents as outlined in the U. S. P. should be carefully explained as well as the various other assay processes recognized by the U. S. P.; and the assay of a few typical drugs selected from the following list should be made in the laboratory. Tests of identity should be made with the extracted alkaloids.

Special processes

Morphine in opium or its preparations

Sawdust method

Alkaloids in fluidextract of aconite

Alkaloids in fluidextract of cinchona

By immiscible solvents

Alkaloids in ipecac or its preparations

Alkaloids in nux vomica or its preparations

Alkaloids in belladonna or its preparations

Alkaloids in guarana or its preparations

Quinine in iron and quinine citrate

Resin in jalap

BRANCH III—PHARMACY

One hundred and ninety-five hours first year, two hundred and five hours second year, total four hundred hours. Pharmacy is the science and art of preparing, preserving, compounding and dispensing medicines.

The outline assigns definite hours to definite subdivisions for the specific purpose of keeping in mind the maximum of information to be imparted in the minimum possible time, so that each branch of the whole subject of pharmacology shall receive its adequate and proper consideration. Nor is it considered that some subjects are minor subjects which can be taken away from other subjects considered as major.

FIRST YEAR

The instruction of the first year includes pharmaceutical arithmetic thirty hours, pharmaceutical Latin twenty-five hours, theory of pharmacy sixty hours, laboratory practice twenty hours, and manufacturing pharmacy sixty hours.

PHARMACEUTICAL ARITHMETIC. Thirty hours.

The arithmetic pertaining to the science and art of pharmacy. In this course the parts of general arithmetic used in pharmaceutical work should be thoroughly reviewed and additional parts studied. The ability to use the various weights and measures easily and accurately is one of the principle objects to be attained by the student. Since the Pharmacopoeia uses the metric system exclusively and this system is used extensively in scientific work, it should be thoroughly studied.

Review common fractions

Review decimal fractions

Metric system of weights and measures

United States system of weights and measures.

Imperial system of weights and measures

Relationships of metric and the United States systems of weights and measures

Relationships of imperial and the United States systems of weights and measures

Computation of doses
Ratio and proportion
Reducing and enlarging formulas
Specific gravity and specific volume
Weights of given volumes and volumes of given weights
Thermometer scales
Percentage solutions, dilutions, and concentrations
Alligation
Chemical problems

PHARMACEUTICAL LATIN. Twenty-five hours.

The Latin pertaining to the science and art of pharmacy.

In a Latin course of but twenty-five hours it is evident that all ordinary methods of treating the subject must be set aside. Only such essentials of inflection and syntax can be taught as will serve the practical purpose of enabling the student to read prescriptions with ease and intelligence. With this end in view the following specific recommendations are made:

Pronunciation. Preference should be given to the English method because it is easier and more in accord with the prevailing pronunciation of American pharmacists.

Vocabularies. Every lesson should include a Latin vocabulary of at least twenty pharmaceutical words. The student should be required to write these correctly when the English equivalents are given. Mistakes in spelling often have serious results. It is important therefore that frequent exercises in correcting such errors should be given.

Declensions. The simpler uses of four cases, nominative, genitive, accusative, ablative.

Conjugation. The essential forms of the verb are:

Active imperative present, second singular

Active subjunctive present, third singular and plural

Passive subjunctive present, third singular and plural

Present and perfect participles and gerundive

These forms should be given for the four regular conjugations, together with the verbs in *-io* and the irregular verbs *sum* and *fio*.

Comparison. A brief statement of the Latin method of comparison of adjectives will comprise all that time will permit.

Numerals. Thorough drill should be given on the cardinals from *unus* to *mille*, together with the declension of *unus*, *duo*, *tres* and *mille*. The ordinals from *primus* to *centesimus* are also important.

Abbreviations. These should not be grouped in a single chapter as they are difficult to memorize and very elusive. A certain number of them with their full form and meaning should be given in each lesson and should be frequently reviewed.

Latin exercises. These exercises should include many pharmacopœial titles and parts of prescriptions as well as illustrative sentences. The translation of English prescriptions into Latin will be found to be a useful exercise.

Prescriptions. The reading of prescriptions should be begun as early in the course as possible. Ultimately the student should be able to write in Latin the full form of any prescription in every detail of the title and quantity of the drugs, as well as the abbreviations and to give a correct English translation of the same.

THEORY OF PHARMACY. Sixty hours.

The exposition of the principles upon which pharmaceutical operations are based.

Under this subdivision the committee has endeavored to present the essentials of a course of didactic lectures and laboratory instruction in the more important features of operative pharmacy.

It will be noted that the subject of metrology including the determination of specific gravities has been retained under this head instead of relegating it to the department of pharmaceutical arithmetic, which will probably have the approval of the most of those who give instruction in this branch.

No attempt has been made to apportion the hours among the several subdivisions of the subject. This function should be left largely to the instructor.

Pharmaceutical technique

Operative pharmacy

Amplifications of the divisions

General considerations

Subject-matter of pharmacology

Pharmacology

Botany

Pharmacognosy

Microscopy

Physiology

Materia medica

Toxicology-posology

Chemistry

Pharmacy

Theory and practice

Literature of pharmacy

Pharmacopœias and formularies

Foreign pharmacopœias

United States Pharmacopœia

National Formulary

Commentaries

Dispensatories

Progress of pharmacy

Pharmaceutical journals

Association proceedings

National associations

State associations

Local associations

Metrology

Measurement, comparison of thing measured with
selected standard units

Kinds of measurement

Quantities of matter

Quantities of force

Quantities of energy

Measurement of matter

Measure of extension

One direction — linear measure

Two directions — square measure

Three directions — cubic or volume measure

Measure of weight or of gravitative force

Scientific system

Should be based on a natural invariable standard

Primary units should be easily comparable with each other

Orders of units should increase and decrease in a simple ratio

Names of units should indicate their magnitude and kind of measure

Common systems of weights and measures

In common use by English-speaking nations

Weights

Imperial or avoirdupois

Used in the United States for commercial purposes only and in the British Empire for both commercial purposes and pharmaceutical compounding

Table of units and symbols

Methods of writing avoirdupois quantities

Apothecaries' weight

Commonly employed in writing prescriptions

Table of units and symbols

Methods of writing quantities in apothecaries' system

Comparison of apothecaries' and avoirdupois weights

Differences in units and symbols

Liquid volume or cubic measure

Imperial liquid measure

Relation to imperial or avoirdupois weight

Table of imperial measure

Methods of writing quantities in imperial measure

United States wine or apothecaries' liquid measure

Use in United States for commercial purposes and in compounding prescriptions

Table of apothecaries' measure

Method of expressing quantities in apothecaries' measure

Comparison of imperial and United States wine measure

Differences in volume of units having the same names, differences in notation

Common domestic measures

Drop, teaspoonful, dessertspoonful, tablespoonful,
wineglassful, teacupful

Metric system of weights and measures

Derivation of fundamental and primary units

Derivation of units names and numeral prefixes

Tables of metric weights and measures

Methods of expressing quantities in terms of metric
weight and measure

Equivalents of metric units in terms of the common
systems

Weighing machines

Modern forms

Scales and balances

Classification of balances

Spring and lever

Law of the balance

Classification of lever balances

Simple and compound

Equal and unequal arms

Torsion balances

Styles of balances for commercial purposes

Counter scales

Platform scales

Styles of prescription balances

Pans below beam

Pans above beam

The analytical balance

Construction and material

Bearings

Rules for use and care

Requisites of accurate prescription and analytical balances

Equal length of arms

Location of center of gravity

Parallelism of knife edges

Agate bearings

Method of weighing

Direct

By reversal

- By substitution
 - Gross weight
 - Net weight
 - Tare
- Forms of weights
 - Materials
 - Iron
 - Brass
 - Platinum
 - Aluminum
 - Common styles
 - Pyramid weights
 - Block weights
 - Cup weights
 - Prescription and analytical
 - Coin weights
 - Block weights
 - Sheet brass, aluminum and platinum
 - Wire weights
 - Riders
- Vessels used in measuring liquids
 - Materials employed in measuring vessels
 - Glass, metals
 - Methods of graduation
 - To contain or deliver
 - Single volume and divided volume measures
 - Styles of measuring vessels
 - Graduates
 - Medicine glasses
 - Flasks
 - Cylinders, stoppered and open
 - Burettes
 - Pipettes,
 - Certification and calibration of graduated glass vessels
- Specific gravity
 - Density, absolute and relative, with definitions and illustrations of specific gravity
 - Standards of density
 - Solids and liquids
 - Gases and vapors

- Data required for specific gravity calculations
 - Weight and volume of substance
 - Weight of equal volume of standard
- Specific gravity of liquids
 - By pycnometer or specific gravity bottle
 - Improvised pycnometer
 - Other styles of pycnometer, Squibb's
 - By loss of weight in immersed body
- Hydrometers
 - Styles of
 - Arbitrary scales
 - Specific gravity scale
- Specific gravity of solids
 - From loss of weight in water
 - Solids heavier than water
 - Solids lighter than water
 - From volume of water displaced
 - Illustrations
 - By use of pycnometer
 - Illustrations
- Specific gravity of solids soluble in water
 - Illustrations
- Specific volume
 - Definition
 - Relation to specific gravity
 - Methods of determination and calculation
 - Pharmaceutical applications
- Heat and its pharmaceutical applications
 - Sources of heat
 - Natural
 - Electrical
 - Combustion of fuel
- Thermometry
 - Temperature, heat intensity
- Thermometers
 - Fixed points
 - Thermometer scales, Fahrenheit, centigrade, Reaumur
 - Comparison and conversion of thermometric scales
 - Styles of thermometers and applications in pharmacy

- Combustion
 - Nature
 - Combustible elements of fuels
- Conditions of combustion
 - Igniting point of fuels
 - Supply of oxygen
 - Removal of products of combustion
 - Test of perfect combustion
- Solid fuels
 - Coal, coke, wood, charcoal
 - Appliances for burning solid fuels
- Liquid fuels
 - Petroleum, gasoline
 - Lamps and stoves
 - Alcohol, methyl, ethyl and denatured
 - Lamps and burners
- Gaseous fuels
 - Natural, coal and water gases
 - Gas burners, stoves, and appliances
 - Blowpipe, simple, compound, oxyhydrogen
- Regulation and application of heat
 - Desiccation and exsiccation
 - Uses
 - Appliances
 - Torrefaction and carbonization
 - Uses and appliances
 - Ignition, incineration and calcination
 - Pharmaceutical uses and appliances
- Use of baths
 - Water, saline, oil, glycerin, sand, steam
 - Constant level water baths
- Uses of superheated steam
 - Appliances
- Evaporation below boiling point
 - Conditions
- Evaporation by boiling
 - Theory
 - Vapor pressure
- Evaporation under diminished pressure

Evaporating dishes and appliances

Materials

Styles

Sterilization

Objects

Methods

Distillation

Definition

Alembic and retort stills

Dome stills and worm condenser

Flask still and Liebig condenser

Special pharmaceutical stills, Remington, etc.

Alcohol stills, rectifying columns

Distillation under diminished pressure

Theory

Purpose

Appliances

Fractional distillation

Theory

Influence of vapor tension

Appliances

Sublimation

Cake sublimates

Powder sublimates

Appliances

Destructive distillation

Theory

Wood: acetic acid, methyl alcohol

Coal: illuminating gas, tar

Bone and animal matter: bone oil, bone-black

Appliances

Refrigeration

Theory

Freezing mixtures

Evaporation of volatile liquids

Applications in pharmacy

Comminution

Theory and purpose

- Cutting or slicing
 - Object
 - Appliances
- Contusion or bruising
 - Mortars and pestles, materials, kinds, shapes
 - Methods for facilitating contusion
- Rasping and filing
 - Methods and appliances
- Grinding. Drug mills
 - Simple hand mills
 - Construction and rules for operation
 - Power mills
 - Disintegrators
 - Chaser mills
 - Buhr-stone mills
 - Ball mills
 - Pulverizers
- Trituration
 - Methods
 - Styles of mortar and pestle
- Levigation or porphyzation
 - Methods and purpose
- Comminution by use of volatile solvents
 - Camphor
- Comminution of metals
 - Methods
- Comminution by precipitation
 - Methods
- Degrees of comminution
 - Methods of designating
- Sifting
 - Common forms of sieves
 - Sifting media
 - Methods of sifting
 - Mechanical sifters
- Expression
 - Hand expression
 - Twist-press
 - Single screw press
 - Special forms
 - Methods of operation

Fruit presses

Methods of using

Hydraulic or hydrostatic press

Principle of operation

Styles used in fixed oil industries

Expression with heat

Methods of application

Solution

Theory of solution

Solute and solvent

Simple and chemical solution

Distinction

Degrees of saturation

Subsaturated

Saturated

Supersaturated

Effect of heat

Rate of solution

Solubility

Law of solvents

Simple solvents

Water, alcohol, glycerin, ether

Compound solvents

Effect of solution on

Density

Boiling point

Freezing

Chemical activity

Solution of gases

Liquefaction of gases

Theory

Critical point

Handling and storage in the pharmacy

Separation of liquids from solids

Centrifugal separations

Theory of centrifugal action

Centrifugal machines

Use in microscopy and urinalysis

Use on manufacturing scale

Colation or straining

Forms of strainers

Strainer cloths

Strainer supports

"Hippocrates' sleeve"

Sieve strainers

Colanders

Filtration

Definition, distinction from colation

Mass filters, sand, glass-wool, asbestos, charcoal

Felted cloth

Paper

Folded filters

Plain

Fluted

Unbaked porcelain

Pasteur and Chamberlain filters

Pressure filtration

Filter pumps

Mechanical filters

Funnels

Material

Angle of sides

Büchner funnel

Ribbed or fluted funnels

Hot filtration

Objects

Methods

Appliances and application in pharmacy

Funnel supports

Wooden supports

Metal supports

Ring stands

Movable

Fixed

Osmosis

General principles

Crystalloids and colloids

Dialysis

- Construction of dialyzer
- Diffusate and dialysate
- Conditions for efficient dialysis
- Pharmaceutical applications

Precipitation

Chemical precipitation

- Change in molecular aggregation, e. g., coagulation of albumin
- Through slow oxidation, e.g., in fluidextracts
- Double decomposition
- Influence of heat and concentration
- Precipitating jars

Physical precipitation

- By change of solvents, e. g., adding alcohol to aqueous solutions of sulphates, acacia

Washing of precipitates

Washing precipitates on filter

- Methods
- Spritz bottle
- Guiding rod

Washing by decantation

- Theory
- Vessels

Use of the siphon

- Theory
- Methods

Elutriation

- Methods
- Pharmaceutical applications

Clarification and decoloration

Clarification

- Theory
- Materials and methods
 - Paper-pulp
 - Egg albumin

Decoloration

- Theory

Materials and methods

Charcoal, vegetable, animal

Fuller's earth

Alumina cream

Separation of immiscible liquids

Effect of gravity on mutually insoluble liquors

Formation of emulsions

Destruction of emulsions

Separators

Centrifugal separators

Spritze bottle style of separator

Improvised separatory funnel

Separators with glass stop-cocks

Patterns

Extraction of drugs by solvents

Character of drugs requiring extraction

Lixiviation

Definition, methods, illustrations

Pharmaceutical applications

Maceration

Definition, methods

Pharmaceutical applications

Circulatory displacement

Definition, method

Applications in pharmacy

• Digestion

At gentle heat

At boiling temperature

Use of reflux or return condenser

Percolation

Theory

Types of percolators

Conical

Cylindrical

Narrow cylindrical

Fitting of percolators

Cotton and sand

Cork and control tube

Sprinkler-top control

Process of percolation

Moistening the powder

Method and object

Saturation and preliminary maceration

Method and object

Packing

Filter-paper cover and weight

Percolating jar

Conditions of perfect percolation

Fineness of powder

Firmness of packing

Character of menstruum

Shape of percolator

Rate of flow, use of control tube

Conditions which determine choice of menstruum

Oily and resinous drugs

Astringent drugs

Alkaloidal drugs

Tests for complete extraction

Color and taste of percolate

Special methods of percolation

Squibb or well-tube percolator

Theory and construction

Siphon control tube

Pressure percolation

Theory

Anderson's pressure percolator

Other styles

Repercolation or fractional percolation

Theory and method

Application to fluidextracts

Percolation with volatile menstrea

Method

Application in pharmacy

Continuous percolation

Theory

Improvised apparatus

Soxhlet's apparatus

Extraction tubes

Crystallization and crystallography

Crystallization

Theory

Amorphous bodies

Description of crystalline forms

Face, edge, angle, axis

Prismatic, tabular, acicular, laminar

Isomorphous, dimorphous, polymorphous

Production of crystals

Fusion and cooling

Sublimation

From supersaturated solutions

Mother liquor

Precipitation

Crystallizing vessels

Glass, earthenware, wood

Conditions which affect crystallization

Rest and agitation

Cooling

Presence of nuclei

Water of crystallization

Distinction from interstitial water

Efflorescence, exsiccation

Deliquescence, hygroscopic crystals

Crystallography

Crystal systems with examples

LABORATORY PRACTICE. Twenty hours.

The selection of the particular line of experiments to accompany a course of lectures upon pharmaceutical technique must necessarily be left largely to the judgment of the instructor, his choice naturally depending upon his opinion as to what portions of the subject need the emphasis of laboratory work.

The character of the experiments which may appropriately be given as a part of this course will also depend in large measure upon the line of work in the galenical laboratory, since the latter when fairly comprehensive may include all or nearly all of the processes and methods commonly considered under the head of operative pharmacy.

The considerations above have led to the indication of what might properly be denominated an elementary course of experiments to be pursued as an introduction to galenical work leaving the dictation of details to the discretion of the instructor.

Practice in weights and measures

- Comparison of metric and common, linear and square measures

- Measure laboratory, tables, height of student, etc., by means of meterstick and footrule

- Draw diagrams of laboratory and furniture on scale of 2 centimeters to meter, and $\frac{1}{4}$ inch to foot, for comparison

- Ascertain approximate values of the inch, foot, and yard in centimeters

- Comparison of metric and apothecaries' liquid measures

- Ascertain approximate value of fluidounce and fluidrachm in mils

- Ascertain approximate value of mil in minims

- Ascertain capacity of common 1-ounce, 2-ounce, and 4-ounce vials in mils and in fluidrachms

- Comparison of metric and common weights

- Determine the value of the gram in grains

- Value of drachms in grams

- Value of the avoirdupois ounce and apothecaries ounce in grams

- Weighing, wrapping and tying packages

- Practice in weighing out, wrapping, tying and labeling common drugs, organic or inorganic

- List of drugs and quantities to be specified by instructor

Specific gravity determinations for liquids

- Improvised pycnometer

- Students required to calibrate ordinary ounce vial and with the same to determine the specific gravity of liquids submitted by the instructor

- Temperature conditions should be made to conform to U. S. P.

Determination of specific gravity of several liquids by weighing glass stopper successively in water and in the liquid to be determined.

Specific gravity determinations for solids

Heavier than water and insoluble

Determine specific gravity of several insoluble, solid bodies, using the method of loss of weight in water

Lighter than water, insoluble

By same method determine specific gravity of insoluble bodies lighter than water

Solids soluble in water

Determine specific gravity of several bodies soluble in water, e.g., blue vitriol, alum, by using benzin or turpentine, then determine specific gravity of the body

Solids in powder form.

Select powder heavier than and insoluble in water and take specific gravity by use of pycnometer

Use of hydrometers

Use instruments for liquids lighter and liquids heavier than water and determine specific gravity of several U. S. P. liquid preparations

Heat and regulation of temperature

Comparison of thermometers

Take temperature of a liquid, e.g., water at different times while over a source of heat using both centigrade and Fahrenheit instruments and compare results

Absorption of heat by evaporation

Cause volatile liquid, e.g., alcohol, ether, to evaporate rapidly by current of air and note fall of temperature

Absorption of heat by solution

Dissolve certain salts, e.g., ammonium nitrate or chloride in water using thermometer as stirring rod and note fall in temperature

Evolution of heat by solution

Dissolve commercial caustic soda in water, using thermometer as stirring rod and note rise in temperature

Sublimation of solids

Students to improvise sublimation apparatus and sublime one or more bodies

Melting points

Determination of melting points of various substances

Boiling points

Determination of boiling points of selected liquids

In the following processes the particular operation to be performed is to be selected by the instructor

Simple solutions

Saturated solution

Compound solution

Determination of solubility

Crystallization

Granulation

Precipitation

Filtration

Clarification

Purification

Decoloration

Exsiccation

Calcination

Evaporation

Torrefaction

Carbonization

Incineration

Simple distillation

Recovery of alcohol from a galenical, e.g., an old fluidextract, using flask still with Liebig condenser, ascertain alcoholic strength of distillate by specific gravity and U. S. P. alcohol table

Percolation

Equipping percolator with cork and control tube and extraction of a selected drug, following U. S. P. method for extract of colchicum corm omitting evaporation if desired

MANUFACTURING PHARMACY. Sixty hours.

The preparation of pharmaceutical substances.

Prepare the following official preparations and such additional U. S. P. and N. F. preparations as the time will permit, selecting the additional preparations from those which require skill and careful manipulation. Enough classroom time should be taken for the study of the character of the classes of galenicals.

Waters: Prepare camphor water, cinnamon water and phenolated water

Infusions: Prepare an infusion of a common drug using the official formula. Prepare infusion of digitalis, compound infusion of senna and infusion of wild cherry

Decoctions: Prepare a decoction of a common drug using the official formula, logwood as an example.

Mucilages: Prepare mucilage of acacia and mucilage of Irish moss

Vinegars: Prepare vinegar of squill

Syrups: Prepare simple syrup by cold process, syrup of orange, syrup of hypophosphites, syrup of tar, syrup of wild cherry and syrup of ginger

Mixtures: Prepare chalk mixture and compound mixture of glycyrrhiza

Emulsions: Prepare an emulsion using the general N. F. formula, of a fixed oil and of a volatile oil

Prepare emulsion of almond and emulsion of asafetida

Liniments: Prepare lime liniment, camphor liniment and ammonia liniment

Glycerites: Prepare glycerite of starch and glycerite of tannic acid

Honeys: Prepare clarified honey and honey of rose

Confections: Prepare confection of rose

Masses: Prepare mass of ferrous carbonate or mass of mercury

Pills: Make pills of aloes and pills of rhubarb

Troches: Make troches of ammonium chloride or troches of potassium chlorate

Powders: Prepare aromatic powder, compound chalk powder, and compound powder of rhubarb

Triturations: Prepare a trituration using the official formula.

Prepare an oil-sugar using the official formula

SECOND YEAR

The instruction in pharmacy during the second year includes manufacturing pharmacy sixty hours, dispensing pharmacy sixty hours, commercial pharmacy seventy-five hours, and pharmaceutical jurisprudence ten hours.

MANUFACTURING PHARMACY (continued from the first year).
Sixty hours.

Prepare the following official preparations and such additional U. S. P. or N. F. preparations as the time will permit, as far as possible selecting the additional preparations from those which especially require skill and careful manipulation.

Enough classroom time should be taken for the study of the character of the classes of galenicals.

Liquors: prepare compound solution of chlorine, compound solution of cresol, solution of ferric chloride, solution of ferric sulphate, solution potassium arsenite and solution chlorinated soda

Acids: prepare diluted hydriodic acid

Elixirs: prepare aromatic elixir and compound elixir of taraxacum

Tinctures: prepare at least one official tincture by percolation, one by maceration and one by simple solution

Fluidextracts: prepare two or more fluidextracts requiring assay for completion, as belladonna and nux vomica

Extracts: prepare extract of gentian, extract of hyoscyamus and extract of cascara sagrada

Spirits: prepare aromatic spirit of ammonia and spirit of peppermint

Oleoresins: prepare oleoresin of aspidium

Resins: prepare resin of podophyllum

Collodions: prepare collodion and styptic collodion

Oleates: prepare oleate of mercury

Ointments: prepare ointment, ointment of rose-water, ointment of mercuric nitrate and iodine ointment

Cerates: prepare cerate and compound resin cerate

Plasters: prepare adhesive plaster or lead plaster. Spread plasters of ordinary dimensions and for ear

Suppositories: make glycerin suppositories, rectal, urethral and vaginal suppositories with oil of theobroma

Tablets, compressed

Tablet triturates

DISPENSING PHARMACY. Sixty hours.

The time allotted for dispensing pharmacy should be arranged to give a liberal number of hours for actual work in the compounding of prescriptions

Dispensing room

Location and arrangement

Economy of space

Utensils

Prescription

Prescription Latin

Abbreviations, use and danger

Symbols or signs

Receiving

Careful reading before compounding

Labeling

Checking

Filing

Dispensing finished product

Incompatibility

Physical, chemical and therapeutic

Physical incompatibility

Different forms

How to overcome them

When a physician should be consulted

Use of "shake" labels

Chemical incompatibility

Intentional

Harmful

When not to be dispensed

Use of shake labels

Therapeutic incompatibility

Extemporaneous dispensing

Solutions

Simple

Chemical

Order to be followed in adding ingredients

When to use heat

When to be filtered

Ampuls

- Filling and dispensing

Sterilization

Mixtures

- Aids to hold insoluble substances in suspension

- Conditions of insoluble substances before adding to liquid

Emulsions

- Emulsifiers

- Natural emulsions

- Manufactured emulsions

- Gum emulsions

- Egg emulsions

- Volatile oil emulsions

Collodions

- Methods of dispensing

Liniments

- Methods of compounding and dispensing

Pills

- Order in which ingredients should be mixed

- Excipients to be used with reference to character of ingredients in the mass

- Firmness and plasticity of pill mass

- Making pill mass containing volatile oil, silver nitrate, potassium permanganate

- Dividing mass by hand and by machine

- Pill finishers

- Coating of pills, gelatin, sugar, tolu, salol

- Advantages and disadvantages

Capsules

- Method and material used in making hard and soft capsules

- How to fill in a cleanly manner

- When to mass ingredients

- When to dispense in dry form

- Advantages over pills or powder form of administering medicine

Soft capsules

- Use, how to fill and seal them

Powders

- Order in which ingredients should be mixed
- Methods for dividing powders
- Methods for folding powders
- How to dispense volatile, effervescent, efflorescent, deliquescent substances

Cachets

- Method and material used for making
- Method of filling by machine, by hand
- Advantages of use for dispensing large doses of nauseous medicines

Compressed tablets

Tablet triturates

Troches

- Excipients for making the mass
- Methods for cutting the mass

Ointments and cerates

Vehicle

- Manner of incorporation of water, extracts, crystalline and powdered substances
- Use of steel, horn and rubber spatulas
- Use of slab and of mortars in making
- Carefulness in seeing that product is thoroughly smooth before dispensing
- Methods of dispensing, jars, tubes

Petroxolins

- Liquid and solid

Plasters

- Methods for compounding and spreading

Suppositories

- Sizes and kinds
- Vehicle used in making
- Manner of incorporating the medicinal substances
- Hot and cold processes with descriptions of these methods
- Dispensing
- And such additional topics or exercises as the time allotted to the matter will permit

COMMERCIAL PHARMACY. Seventy-five hours.

Includes bookkeeping, business correspondence, commercial and business law and business practice.

Bookkeeping

Necessity of proper books of account

Theory of bookkeeping, single and double entry

Practical bookkeeping, ledger, cash book, journal, supplementary book

Illustration in bookkeeping

Business correspondence

Business letter writing

System

Commercial and business law

Contracts

Definitions, nature and requisite of contracts in general

Essentials of contract

Parties

Offer and acceptance

Consideration

Interpretation of contracts

Discharge of contracts

Banking

Commercial banks

Savings bank

Deposits

Withdrawals

Loans

Presentment

Agency, a contractual relation

Principal and agent

Form of authority

Ratification

Rights and liabilities of principal and agent

Rights and liabilities as to third persons

Partnership

Common law partnership

Formation of partnership

Rights and liabilities of partners

Dissolution of partnership

Limited partnership

Corporations

Formation

Capital stock

Rights and obligations of stockholders

Comparison of partnership and corporations

Property

Personalty

Title in property

Brief references to

Bailments

Common carriers

Insurance

Nature of the contract of insurance

Insurable interest

The contract

Property covered by policy

Written portion of policy

Kinds of policies

Warranty, representation and concealment

Premium

Special provisions

Surrender

Subrogation

Powers of general agents

Limitation upon agent's authority contained in policy

Waiver by agent

Mortgages, chattel and real estate

Leases

Commercial paper and negotiable instruments

Definition

Surety's contract

Joint makers

Statute of frauds

Essentials

Non-essentials

Acceptance

Effect of acceptance

Negotiability

By delivery

By indorsement

Kinds of indorsement

Indorsers, guarantors and sureties

Liabilities distinguished

Accommodation paper

Effect of affixing the word "surety"

Discharge of guarantors and sureties

Illegality, fraud, duress and failure of consideration

Bona fide holders

Requisites

Purchase before maturity

Valuable consideration

Usual course of business

Good faith

Presentment for payment

Days of grace

Place of presentment

Manner of presentment

Protest

Notice of dishonor

Checks

Certification

Negotiability

Bankruptcy

Who may become bankrupt

Rights and duties of bankrupts

Rights of creditors

Preferences

Distribution of assets

Discharge from bankruptcy

Professional and business ethics

Business practice

Commencing business

Location of the store

New stand

Established business

Necessary capital

Size of room and arrangement of space

Selection of store fixtures and furniture

Prescription case, arrangement and furniture

Poison cabinet

Equipment of the laboratory

Selection of shelfware and containers

Stock

- Purchasing stock
- Forms for ordering stock
- Cancellation of orders
- Card index with record of goods bought
- Value of co-operative buying of goods
- Purchasing of goods on time
- Value of discounting bills
- Methods of keeping up stock
- Checking and pricing of pharmaceuticals and supplies
- Inventory or stock taking
- Labeling of goods

Selling goods

Advertising

- Newspaper advertising
- Circulars
- Signs and cards
- Window displays
- Store displays
- Sales-letters
- Meeting competition

Salesmanship

- Analysis of goods
- Analysis of buyers

Profits and earnings

- The sales account
- The expense account
- Gross and net profits
- Profits based on cost and selling price respectively
- Annual profit and loss statement

Pricing of goods

- Department profits
- Overhead and turnover

Collections

- Selling for cash
- Selling for credit
- Monthly statements
- Making collections

PHARMACEUTICAL JURISPRUDENCE. Ten hours.

The laws relating to the practice of pharmacy.

The law relating to the commercial transaction of the pharmacist is given consideration under commercial pharmacy in connection with bookkeeping and banking and with business practice.

Jurisprudence, philosophy and scope

Right and wrong

Universal law

Statutory law, federal and state

Common law and equity

Brief historical consideration

Modification by statute law

Statutory regulations of the practice of pharmacy

History of pharmacy legislation. Analysis of subject-matter covered by state pharmacy acts.

General provisions regarding examination and registration

Federal and state food and drug laws, general provisions of

Federal and state anti-narcotic laws and regulations, general provisions of

Relation of federal and state food and drug laws

Relation of federal and state anti-narcotic laws and regulations

Prohibition laws

Non-beverage alcohol, denatured alcohol

Laws and regulations

Liability of pharmacists

Dual nature

For error in dispensing

For negligence

For act of clerk

For not labeling poisons properly

For attempting to practice medicine

For failure to act in accordance with local ordinances

As manufacturers

SECTION II

THE GRADUATE COURSE

LEADING TO THE DEGREE OF PHARMACEUTICAL CHEMIST (Ph.C.)

While the undergraduate course in pharmacy represents a minimum which should be completed by every candidate for license as a pharmacist and the work has few or no elective parts, entirely different conditions govern the graduate course. In this course the greatest possible latitude is allowed to the schools in the election of subjects to be included, with the intention that each institution will develop an individuality by selecting a great part of the work so as to conform to the special qualifications of its teachers. To this end about two-thirds of the allotted time is to be devoted to required subjects and the remainder to subjects selected by each college from an extended list. As this course leads to the degree of Pharmaceutical Chemist, a large proportion of the time is to be devoted to the study and practice of advanced pharmaceutical chemistry.

REQUIRED SUBJECTS IN THE GRADUATE COURSE

	Hours
Analytical chemistry	300
Bacteriology	75
Manufacturing pharmacy	100

To which are to be added subjects selected by the college from the following list to make up a total of 750 or more hours of instruction:

Organic chemistry	150
Chemical technology	25
Urine analysis	25
Technical microscopy	50
Advanced botany	50
Biological assaying	50
Immunology	25
Dispensing	75

ANALYTICAL CHEMISTRY. Three hundred hours.

Volumetric Analysis

The course should include:

1. The difference between true liters and Mohr liters; in general, the ratio of temperature, volume and weight of liquids
2. The use of various styles of burettes (Mohr, Gay Lussac, Bink, Automatic, etc.), their advantages and disadvantages for various types of volumetric work
3. The use of floats
4. The use of weighing bottles for liquids and solids; also the use of Lunge and other pipettes for weighing
5. The best procedure in keeping the various volumetric solutions
6. Mathematics

Calibration

Calibrating flasks for content and delivery

(a) With water by weighing

(b) With water by volume comparison with a standard flask

(c) With mercury by volume comparison with a standard flask

Calibrating burettes and pipettes

Volumetric solution bases for acidimetry and alkalimetry

Purifying and drying $\text{KHC}_4\text{H}_4\text{O}_6$ (U. S. P. method)

Making normal NaOH (U. S. P.)

Decarbonating NaOH with Ba(OH)_2

Making a syphon reservoir to hold the same

Standardizing the decarbonated NaOH against the pure $\text{KHC}_4\text{H}_4\text{O}_6$

Diluting the NaOH to exactly normal, using CO_2 -free water

Making normal H_2SO_4 (U. S. P.)

Standardizing the H_2SO_4 gravimetrically as BaSO_4

Diluting the H_2SO_4 to exactly normal

Comparing the normal NaOH with the normal H_2SO_4

Making tenth normal NaOH from some of the normal NaOH using CO_2 -free water

Determination of strength of formaldehyde solution U. S. P.

Determining the acetic acid strength of vinegar with tenth normal NaOH, using 6cc of vinegar and calculating by the formula:

$$\frac{\text{cc } n/10 \text{ NaOH}}{10} = \% \text{ of acetic acid}$$

The use of "factor weights" for analysis

The use of various indicators, especially phenolphthalein, methyl orange and methyl red

Chemical reactions occurring when using various indicators

The determinations of alkaline hydroxides, carbonates and bicarbonates, alone and as mixtures

Determination of the strengths of solutions of NaOH, Na_2CO_3 , NaHCO_3 , $\text{NaOH} + \text{Na}_2\text{CO}_3$, $\text{Na}_2\text{CO}_3 + \text{NaHCO}_3$, HCl

Determination of $\text{Ca}(\text{OH})_2$, CaCO_3 , $\text{Ca}(\text{HCO}_3)_2$

Methods of sampling

Determining the percentage strength of concentrated H_2SO_4

Diluting the concentrated H_2SO_4 to 10% H_2SO_4 , using alligation to calculate the proportions

Determination of the strength of the diluted H_2SO_4 thus prepared

Determination of NaOH and Na_2CO_3 in commercial solid sodium hydroxide

Basic solutions for oxidimetry and iodimetry

Purification of $\text{K}_2\text{Cr}_2\text{O}_7$ by repeated recrystallization

Preparation of tenth normal $\text{K}_2\text{Cr}_2\text{O}_7$ (U. S. P.)

Calculation of hydrogen equivalency in oxidimetry

Empirical solutions

Preparation of empirical V. S. $\text{K}_2\text{Cr}_2\text{O}_7$

Determination of iron in iron ore volumetrically with the empirical V. S. $\text{K}_2\text{Cr}_2\text{O}_7$, using SnCl_2 as the reducing agent

Preparation of tenth normal $\text{Na}_2\text{S}_2\text{O}_3$ (U. S. P.)

Standardization of the $\text{Na}_2\text{S}_2\text{O}_3$ against the tenth normal $\text{K}_2\text{Cr}_2\text{O}_7$

- Determination of the strength of tincture of iodine
 - Determination of red lead iodometrically
 - Preparation and standardization of tenth normal iodine solution
 - Assay of Crude Calcium Sulphide
- Preparation of tenth normal KMnO_4 (U. S. P.)
 - Standardization of the V. S. KMnO_4 against the standard $\text{Na}_2\text{S}_2\text{O}_3$
 - Determination of iron in iron ore volumetrically with the V. S. KMnO_4 , using a "reductor" to reduce the iron
 - Determination of total iron in Solution of Ferric Chloride with V. S. KMnO_4 ($\text{Zn} + \text{H}_2\text{SO}_4$ and Bunsen valve method)
 - Determination of ferric iron in Liquor Ferri Chloridi iodometrically
 - Determination of total and of ferrous iron in commercial copperas
- Preparation of Dakin's solution
 - Determination of strength of Dakin's solution
- Preparation of tenth normal NaCl
- Preparation of tenth normal AgNO_3
 - Comparison of tenth normal NaCl and tenth normal AgNO_3
 - Determination of chlorides in city water, etc., with hundredth normal AgNO_3
- Preparation of tenth normal KCNS
 - Determination of KI
- Résumé of comparative stability of the various volumetric solutions with emphasis on the fact that V. S. H_2SO_4 is the most permanent basis for acidimetry and alkalimetry, V. S. $\text{K}_2\text{Cr}_2\text{O}_7$ for oxidimetry and iodimetry, and V. S. NaCl for halogenimetry

Comparative Study of Assay Methods

- Crude Drugs by the assay of
 - Cantharides
 - Hydrastis
 - Scammony Root
 - Opium

Fluid extracts

Belladonna

Cinchona

Tinctures

Colchicum Seed

Hyoscyamus

The identity of the proximate principle obtained should be determined and the assay methods compared with those of the British, French, German and other pharmacopœias.

Volatile Oils

Peppermint

Clove

Cinnamon

Eucalyptus

Lemon

Bitter Almond

Ointments

Zinc oxide

Mercurial

Ferments and Glandular Substances

Pepsin

Pancreatin

Diastase

Suprarenal Glands

Fats

Olive Oil

Saponification value

Iodine value

Expressed oil of almond

Specific gravity

Congealing temperature

Tests for paraffin oil and other fixed oils

Saponification value

Iodine value

Practice in the Use of Special Apparatus

Refractometer

Determining the index of refraction of

Olive Oil

Oil of Bitter Almond

Oil of Anise

Immersion Refractometer

Determination of strength of tenth normal hydrochloric acid

Examination of whey in milk

Polariscope

Assay of spirit of camphor

Estimation of sugar

Before inversion

After inversion

Verify by Cu_2O precipitation

BACTERIOLOGY

Seventy-five hours, the first part of each two or three-hour period being occupied by a lecture covering the day's work.

The instruction covers the ground in elementary bacteriology and corresponds to the work required in such courses in medical schools. Special stress is laid upon such work as is called for in the laboratories of state and municipal health departments. The student makes his own bacteriological media and becomes familiar with the use of all laboratory apparatus.

Introductory: history of earlier bacteriology. Comparatively recent development of modern bacteriology.

Definitions: bacteria, yeasts, molds. Their distribution in nature and their importance from the agricultural and industrial as well as from the medical standpoint. Bacteriology as it applies to the pharmacist.

Parasites and saprophytes; two main divisions of bacteria.

Nutrition, relation to oxygen. Other conditions affecting growth.

Morphology of bacteria. Mode of propagation.

Sterilization: principles, methods, apparatus necessary. Fractional method. Sterilization by pressure. Disinfection compared with sterilization. Chemical agents. Thermal death point of bacteria. Practical experiments in killing spores.

Hand disinfection: alcohol, lime and soda.

Methods of study of bacteria. Isolation of pure cultures. Koch's plate method. Demonstration of different media.

Culture media: bouillon, agar, gelatin, potato, milk, blood serum, Loeffler's. Reference to other special media. Preparation of glassware for use in making media.

Fishing of colonies from cultures poured in Petri dishes and their transfer to agar slants and other media.

Spore formation, germination. Staining methods.

Motility: Brownian movement.

Special stains: Gram's method.

Determination of species: Description of cultures and method of recording on charts.

Analysis of air.

Analysis of soil.

Analysis of milk.

Analysis of water.

Analysis of ice.

Water purification: natural, artificial. Varieties of filters. Bacteriological tests of filters.

Anaerobic bacteria.

Bacteria in their relation to disease. Factors determining pathogenicity. Infection.

Distribution of bacteria in infected body. Animal inoculations. Recovery of bacteria by autopsy. Streak plates from blood. Study of morphology of bacteria in blood and organ smears. Blood cultures.

Methods of obtaining and handling specimens for bacteriological study.

Staphylococcus pyogenes aureus. *Streptococcus pyogenes*. *Pneumococcus*.

Bacillus mucosus capsulatus. Capsule staining.

Special media for study of pneumococci. Types of pneumococci

Bacillus diphtheriae. *Bacillus Xerosis*. *Bacillus Hoffman*.

Gonococcus. *Meningococcus*. *Micrococcus catarrhalis*.

Tuberculosis. Human and bovine. Lesions in guinea-pig. Staining of sputum.

Typhoid — colon group of bacilli. Methods of identification and separation in urine, feces, etc. Agglutination. Widal test.

Cholera and plague.

Spirochæta of syphilis. Vincent's angina.

Spirillum of relapsing fever.

Poliomyelitis. Rabies, Negri bodies in smears.

Molds and yeasts.

Immunity: natural and acquired.

Sera and vaccines. Preparation and uses.

Principles of complement fixation. The Wassermann reaction in syphilis.

Complement fixation tests in gonorrhea.

MANUFACTURING PHARMACY. One hundred hours.

The theory of pharmacy having been presented in all its phases during the two-year course, the third-year course is of necessity largely laboratory and library work.

At least one hour each week must be devoted to recitations.

A monthly review of the current pharmaceutical journals should be required and a seminar of at least one hour once a month.

A notebook must be kept in which all references consulted are to be noted, together with observations made during the exercise. Drawings of apparatus and "set-ups" used should also be shown in the notebook.

When work is assigned the student should be required to consult the reference books at hand for all information necessary to carry out the work.

As the determination of physical constants is presented at the beginning of the first year in the two-year course, it is desirable that this phase of the work be reviewed because of its very considerable use in manufacturing pharmacy. Accuracy and technic to be checked.

Distillation

Study stills and distilling flasks at hand. Prepare 500 cc. aqua hamamelidis by distillation from Remington or Phoenix still.

Aquae

Prepare 500 cc. of one of the following according to the method of the British Pharmacopoeia:

Aqua cari

Aqua menthae piperitae

Cinnamomi

Menthae viridis

Foeniculi

Store carefully and compare later with those made by other pharmacopoeial methods.

Prepare 1,000 cc. of one U. S. P. water by each of the following methods. Aqua cinnamomi must be one of those selected.

1. By intervention
 - a. Using purified talc
 - b. Using purified siliceous earth
 - c. Using filter paper
 - d. Using calcium phosphate
2. By shaking with recently boiled distilled water and filtering
3. By distillation
 - a. Process of U. S. P. and B. P.
 - b. Process of Deutsches Arzneibuch

Determine the cinnamic acid in the cinnamon water.

Determine the cinnamic aldehyde in the cinnamon water.

Divide 1,000 cc. of one of the waters into four portions.

and store in freshly sterilized bottles as follows:

1. Glass stoppered
2. Cork stoppered
3. Cotton stoppered
4. Amber-colored glass stoppered

Place where they can be seen every day and examine them four months later.

Liquores

Prepare 500 cc. of at least two of the following. All U. S. P. tests must be applied, the product assayed and brought up to the U. S. P. or N. F. standards.

Liquor arseni et hydrargyri Liquor sodii glycerophosphatis
iodidi

Ferri subsulphatis
Formaldehydi
Hydrogenii dioxidi
Magnesii citratis

Zinci chloridi
Ferri protochloridi
Ferri oxychloridi
Phosphori
Hypophysis

Spiriti

Prepare 25 cc. spiritus aurantii compositus. Use particular care in measuring, and, in case a cloudy mixture results, make all the U. S. P. tests on each of the oils to determine the cause of cloudiness.

Prepare a sample of spiritus aetheris nitrosi, using a tube of the concentrated solution supplied by manufacturing houses. Assay the sample.

Elixiria

Prepare 500 cc. of two of the following:

Elixir pepsini et bismuthi
Calcii lactophosphatis
Ferri, quininae et strychninae phosphatum
Phosphori
Sodii salicylatis compositus
Glycyrrhizae aquosum

Petroxolina

Apply viscosity test to petrolatum liquidum used.

Prepare 100 Gm. each of two of the following:

Petroxolinum guaiacolis Petroxolinum iodoformi
Hydrargyri Spissum
Iodi Sulphuratum
Phenolis camphoratum

Glycerita

Prepare 200 Gm. of each of the following:

Glyceritum guaiaci
Bismuthi
Picis liquidae

Syrupi

Prepare 500 cc. each of two of the following:

Syrupus picis liquidae (percolation)
Calcii iodidi
Cinnamomi
Ferri, quininae et strychninae phosphatum
Iodotannicus
Asari compositus
Ferri et mangani iodidi
Papaveris
Sennae aromaticus
Mannae

Magmae

Prepare 250 Gm. each of magma bismuthi and magma magnesi.

Emulsa

Prepare 250 cc. each:

Emulsum olei morrhuae cum malto
Petrolati

Prepare emulsions using various other emulsifying agents,
Mucilage of chondrus
Glycerite of egg yolk
Indian gum
Casein

and make comparisons of the suspending powers and stabilities.

Unguenta

Use "pebble mill" to reduce salts to fine powder if necessary.

Use ointment mill and prepare 1,000 Gm. of one of the following:

Unguentum calaminae
Plumbi iodidi
Sulphuris alkalinum
Sulphuris compositum
Zinci stearatis

Suppositoria

Prepare 12 suppositories of each of two of the following compositions:

- a. Phenol 5%
- b. Lead acetate 20% and opium 5%
- c. Mercury 20%
- d. Hydrated chloral

Ampulae

Prepare and sterilize 12 ampuls of one of the following:

- a. Camphor in oil, 3 gr.
- b. Iodoform in oil, 1 gr.
- c. Sodium cacodylate, 3 gr.
- d. Iron citrate, 1 gr.

Fluidglycerata

Prepare 500 cc. of one of the following:

Fluidglyceratum cascarae sagradae
Cascarae sagradae aromaticum
Sennae
Krameriae
Rhei

Oleoresinae

Using 250 Gm. of drug, prepare one of the following:

Oleoresina aspidii
Capsici
Cubebae
Petroselini
Piperis
Zingiberis

Mullae

Prepare one of the official mulls, spreading it and folding in a convenient manner for dispensing.

Mulla acidi salicylici
Creosoti salicylata
Hydrargyri chloridi corrosivi
Zinci

Stili dilubiles

Prepare 20 pencils of one of the following formulas:

Salicylic acid, 20%
Phenol, 5%
Camphor, 10%
Veratrine, 4%
Resorcinol, 10%
Alum, 20%
Menthol, 5%
Lead acetate, 5%

Salia effervescentia

Use the National Formulary directions and prepare by granulation in an oven one of the following:

1,000 Gm.	Sal	kissingense	factitium	effervescens	
250 Gm.	"	lithii	citratis	"	
500 Gm.	"	potassii	bromidi	"	
250 Gm.	"	"	"	"	compositus
1,000 Gm.	"	vichyanum	factitium	"	
250 Gm.	"	"	"	"	cum lithio
1,000 Gm.	"	carolinum	"	"	

Trochisci

Prepare 100 troches of each of two of the following:

Trochisci acidi tannici

Cubebae
 Sodii bicarbonatis
 Carbonis ligni
 Gambir
 Menthae piperitae
 Potassii chloratis
 Quininae tannatis
 Santonini
 Santonini compositi
 Sulphuris et potassii bitartratis
 Ulmi

Cerata

Prepare 100 Gm. of cerate using one of the following as a basis:

Camphor, 2%
 Menthol, 3%
 Menthol, 2%, thymol, 0.1%, eucalyptol, 0.2%
 Methyl salicylate, 5%
 Tannic acid, 5%
 Tar, 10%

Next put the cerate up in some attractive form; in a package which could be dispensed over the prescription counter or marketed as distinctive.

Tinctura

The drug to be issued whole, then ground by the student and sifted to uniform fineness for extraction. So far as possible the drug should be grown at the school as part of the students' class work.

Prepare 500 cc. of one tincture from each of the following groups:

- | | |
|----------------------------------|-------------------------------------|
| <i>a. Tinctura calendulae</i> | <i>c. Tinctura colchici seminis</i> |
| Rhei et gentianae | Hydrastis |
| Lavendulae composita | Nucis vomicae |
| Benzoini | Aconiti |
| Myrrhae | Hyoscyami |
|
<i>b. Tinctura digitalis</i> |
<i>d. Tinctura scillae</i> |
| Calumbae | Rhei aquosa |
| Lobeliae | Ferri citro-chloridi |
| Veratri viridis | |
| Sumbul | |
| Valerianae ammoniatae | |

Where there is an official assay process the process must be carried out and the tincture brought to exact standard.

Pulveres

Use the "pebble" or "jar" mill and prepare one of the following:

- Pulvis antisepticus
- Cretae aromaticus
- Gambir compositus
- Hydrargyri chloridi mitis et jalapae
- Myrica compositus
- Talci compositus
- Aromaticus rubefaciens

Capsulae

Prepare 12 soft capsules of one of the following:

- a. Oleum santali, 10 minims*
- b. Oleum ricini, 15 minims*
- c. Oleum santali, 10 minims; methylthioninae chloridum, 2 gr.*
- d. Copaiba, 10 minims*
- e. Oleoresina aspidii, 15 minims*

Fluidextracta

The drug should be ground and sifted to uniform fineness by the student. So far as climatic conditions and facilities permit the drug should be grown and gathered by the student.

Prepare 500 cc. of five of the following fluidextracts, selecting one to be made by each of the official type processes and one by special process. Where there is an assay process directed, make the assay and bring the fluidextract to the standard directed.

- | | |
|---|--|
| <p><i>a.</i> Fluidextractum sabal</p> <p>Sumbul</p> <p>Boldi</p> <p>Calendulae</p> <p>Chimaphilae</p> | <p><i>d.</i> Fluidextractum sennae</p> <p>Spigeliae</p> <p>Glycyrrhizae</p> <p>Eupatorii</p> <p>Leptandrae</p> |
| <p><i>b.</i> Fluidextractum lobeliae</p> <p>Apocyni</p> <p>Calumbae</p> <p>Corni</p> <p>Rosae</p> | <p><i>e.</i> Fluidextractum hyoscyami</p> <p>Colchici cormi</p> <p>Cinchonae aquosum</p> <p>Scillae</p> |
| <p><i>c.</i> Fluidextractum cascarae sagradae</p> <p>Frangulae</p> <p>Convallariae radiceis</p> <p>Fuci</p> <p>Thujae</p> | |

Recover alcohol from weak percolate and marc by distillation under reduced pressure.

Pilulae

Prepare 100 pills of each of two of the following:

- | | |
|-------------------------|---------------------------|
| Glycerylis nitratis | Argenti nitratis, 1/5 gr. |
| Potassii permanganatis, | Opii, digitalis et quinae |
| 1/4 gr. | Laxativae compositae |
| Rhei | Colocynthis compositae |
| Opii et camphorae | Aloini |
| Creosoti, 2 min. | |

Coat one set with sugar, cocoa, or gelatin.

Make enteric pills, coat one portion with salol, another with stearic acid.

Tabletæ

Prepare a convenient quantity of compressed tablets. Use motor-driven machine if available; if not, use one of the hand machines. The student must granulate and dry the mixture.

Type tablets.

Acetanilid, 1 gr.

Charcoal, 5 gr.

Salicylic acid, 5 gr.

Monobromated camphor, 3 gr.

Lead acetate, 1 gr.

Dover's powder, $2\frac{1}{2}$ gr.**Acetanilidum**

Prepare a convenient quantity. Apply all U. S. P. tests.

Acidum oxalicum

Make a convenient quantity of oxalic acid using sawdust as the source. Consult reference works for data, then confer with instructor.

Aloinum

Prepare a convenient quantity of aloin. After obtaining data, confer with instructor.

Iodoformum

Prepare a convenient quantity of iodoform. After obtaining data from reference works, consult instructor.

Dentifrices

Prepare 100 Gm. of an approved tooth paste and place in tubes.

Toilet creams

Prepare 100 Gm. of an approved greaseless cream

Prepare 100 Gm. of a modified unguentum aquae rosae.

If motor-driven machinery is available these quantities should be increased to at least 1,000 Gm.

Toilet water

Prepare 500 cc. of toilet water

Face powder

Prepare 100 Gm. face powder

SYNTHETIC ORGANIC CHEMISTRY. One hundred and fifty hours.

This course includes certain types of organic chemical reactions. Instruction should deal not merely with the particular compound being made but may advantageously bring under observation other compounds of that particular class, noting the changes of procedure necessary in their preparation. The properties, reactions and uses of the

various compounds should be discussed. The students should calculate the theoretical amounts of substances needed for the reactions and critically compare them with the quantities actually used; they should also calculate the theoretical yields and compare them with the amounts actually obtained.

Ethyl bromide from ethyl alcohol, NaBr and conc. H_2SO_4
Ethyl iodide from ethyl alcohol, red P and I
Acetyl chloride from acetic acid and PCl_3
Acetic anhydride from acetyl chloride
Acetamide from ammonium acetate
Ethyl acetate from ethyl alcohol and acetic acid
Acetaldehyde and aldehyde-ammonia from ethyl alcohol
Ethylene bromide from ethyl alcohol
Ethylene alcohol (glycol) from ethylene bromide
Nitrobenzene from benzene
Dinitrobenzene from nitrobenzene
Aniline from nitrobenzene
Nitroaniline from dinitrobenzene
Acetanilid from aniline
Ether from alcohol
Chloroform
Phenol from aniline
Sulphanilic acid from aniline

CHEMICAL TECHNOLOGY. Twenty-five hours.

This course is intended to familiarize the student with the most important chemical commercial processes, those processes which are the very basis of all chemical industry.

Sulphuric acid manufacture

Sulphur
Sulphides
 Pyrites
 Zinc sulphide
Chamber process
Contact processes

Nitric acid

Sodium nitrate
Electrolytic

Ammonia

- Destructive distillation
- From atmospheric nitrogen
 - Electrolytic processes
- Cyanamid

Soda manufacture

- Salt
 - LeBlanc process
 - Hargreaves and Robinson's
 - Recovery of sulphur
 - Solvay process
- Kryolith soda
- Alum

Chlorine

- Deacon's process
- Electrolytic process

ANALYSIS OF THE URINE. Twenty-five hours.

Lectures and laboratory work, the lectures occupying the first part of each two or three-hour period. The instruction is intended to prepare the student to make a thorough clinical examination of the urine. After the separate study of each of the important normal and abnormal constituents, complete analyses of several samples of urine should be made.

Introduction**Food**

- Uses, assimilation
- Elimination of body wastes
 - Bowels, lungs, skin, kidneys
- Secretion and excretion of the urine
- Composition of normal urine
 - Variations in composition
- Quantity of urine
- Collection of urine for examination
 - Changes in the urine on standing
- Physical characteristics of the urine
 - Color, odor, sediment
 - Specific gravity
- Chemical reaction of the urine

Normal constituents

Urea: composition, amount and its variation

Determination: sodium hypobromite method, ureometers,
other methods

Uric acid

Comparative test, determination with uricometer, gravi-
metric determination

Indican

Obermeyer's test

Chlorides

Amount and its variation

Comparative test

Centrifugal estimation

Phosphates

Amount and its variation

Comparative test

Centrifugal estimation

Sulphates

Amount and its variation

Comparative test

Centrifugal estimation

Other normal constituents

Abnormal constituents

Sugar

Significance, composition

Detection

Fehling, Haines, Benedict, Boettger, fermentation
tests

Estimation

Benedict, Fehling, fermentation methods

Albumin

Significance

Detection

Heat, nitric acid, picric acid, and other tests

Estimation

Esbach, gravimetric, centrifugal and other methods

Bile

Significance

Detection

Other abnormal constituents**Microscopical examination of urinary sediments**

Importance, need of experience in the work

Unorganized

Uric acid and urates

Phosphates

Oxalates

Creatinin

Others

Organized

Epithelia

Pus

Blood

Spermatozoa

Casts

Bacteria

Others

ADVANCED BOTANY. Fifty hours.

Fifty hours is too short a period for division among different branches of the work, and is sufficient only for a fair course of study of a single subject. Of the available subjects, that of systematic botany or taxonomy appears by far the most important for us, its object being to present a general idea of the system of plants and to afford practice in plant classification and determination by the use of descriptive works. The student should be introduced to and taught the use of such universal works as the *Pflanzen-Familien* of Engler and Prantl, the *Genera-Plantarum* of Bentham and Hooker and some of the monographs of families, and should be taught the use of the descriptive flora of the region in which his school is located. He should also study in the laboratory types of the principal families of plants, especially those which are rich in active medicinal and poisonous principles.

Types of monocotyledonous and dicotyledonous plants, with and without endosperm:

Pinaceæ. A species each of pinus, picea, and juniperus.

Taxaceæ. A species of taxus.

Gramineæ. A species each of phleum, panicum, and agrostis.

Liliaceæ. A species each of aloe, allium and polygonatum.

Smilaceæ. A species of smilax.

Fagaceæ. A species of quercus.

Aristolochiaceæ. A species of aristolochia.

Ranunculaceæ. A species each of actea or of cimicifuga, delphinium, and aconitum.

Cruciferæ. A species of brassica.

Lauraceæ. Sassafras and laurus.

Rosaceæ. A species each of rosa, rubus, crataegus and prunus.

Leguminosæ. A species each of cassia, acacia, phaseolus and baptisia.

Rutaceæ. A species each of xanthoxylum and citrus.

Euphorbiaceæ. A species each of ricinus and euphorbia.

Anacardiaceæ. A species of rhus.

Rhamnaceæ. A species of rhamnus.

Malvaceæ. A species each of malva and sida.

Myrtaceæ. A species each of eucalyptus, pimenta and eugenia.

Umbelliferæ. Daucus, petroselinum and conium.

Loganiaceæ. Spigelia and gelsemium.

Apocynaceæ. A species each of apocynum and nerium.

Labiataæ. A species each of mentha, lavandula and salvia.

Solanaceæ. A species of solanum and atropa.

Rubiaceæ. A species each of cinchona, coffea, psychotria and cephalanthus.

Caprifoliaceæ. A species of viburnum and sambucus.

Lobeliaceæ. A species of lobelia.

Compositæ. A species each of helianthus, erigeron, eupatorium, lappa and chrysanthemum.

Cichoriaceæ. Cichorium and taraxacum.

TECHNICAL MICROSCOPY. Fifty hours.

Practical exercises in general methods

Sectioning

Fresh materials

Fixing

Dehydration

Clearing

Paraffin and celloidin infiltration

Embedding

Removal of embedding media after sectioning

Staining in mass

Dried materials

Maceration

Dehydration

Clearing

Paraffin and celloidin infiltration

Embedding

Hard materials

Grinding

Machine and hand microtomes

Operation, adjustment and care

Mounting media

Methods of preparation

Selection of proper medium

Staining

Methods

Preparation of commonly used stains

Double or contrast staining

Microchemical reagents

Methods of application

Reactions involved

Use and application of accessories

Micromasurements

Stage and ocular micrometers

Standardization of rulings

Filar micrometers

Counting chambers

Mechanical stages

Polarization

- Physical concepts of polarized light
- Applications in drug and food microscopy

Opaque illumination

- Vertical illuminators
 - Construction
 - Applications

Dark field illumination

- Condenser stops
- Reflecting condensers
- Applications

Microphotography

- Types of microphotographic apparatus
- Illumination
- Preparation of specimens
- Operation of apparatus

Micro-analysis of drug products**Preparation of samples for examination**

- Separation of chemical and vegetable constituents
- Powdering
- Sectioning
- Clearing
 - Crude fiber method
- Staining
- Mounting

Application of accessories

- Polarizing microscope
- Opaque illumination
- Dark field illumination

Use of microchemical reagents**Methods of procedure for identification of constituents**

- Classification of vegetable substances according to histological structure and characters
- Use of analytical keys
- Elimination
- Reference books
- Standard specimens

Drug adulterants

- Approximate estimation

- Use of counting plates and chambers

Micro-examination of drugs and drug residues

Applications of microscopical methods to examinations of pharmaceutical and medicinal products

Micro-analysis of food products**Preparation of samples for examination**

- Separation of vegetable constituents and removal of interfering materials

 - Maceration

 - Extraction

 - Solution

 - Sifting

 - Immiscible liquids

 - Elutriation and sedimentation

- Powdering

- Sectioning

- Clearing

 - Crude fiber method

- Staining

- Mounting

Micro-examination of cereals, cereal flours, mixed flours and pastry products

- Insect infection

Micro-examination of spices

- Approximate estimation of adulterants

- Relations of microscopical examination to chemical examinations

Micro-examination of tomato products

- Mold, yeast, spore and bacterial counts

Microscopical examination of confectionery

- Removal of soluble constituents

Micro-examination of fruit products

- Jams, marmalades, pie and pastry fillings

Micro-examination of coffee, tea and cocoa

BIOLOGIC ASSAYING. Fifty hours.

The course should include lectures and demonstrations by the professor, supplemented by actual laboratory work by the students.

The lectures should cover the whole subject in general, and the table demonstrations on living animals should be such as to acquaint the students with the more common apparatus and methods employed for this work.

The laboratory course should give sufficient instruction and practice in technic, handling of and operating on animals, construction and handling of apparatus and actual experience in standardization work to enable the student to carry out such pharmacodynamic assays as are required by the U. S. P.

The minimum course of study should include the following:

Preliminary considerations**Introductory**

Definitions

Development

History

Drugs requiring biochemic assay

Necessity for biologic assay methods

Type methods available for the pharmacodynamic study and standardization of the vegetable and animal drugs

Description and use of simple apparatus used for pharmacodynamic experiments.

Toxic methods

Methods based upon the amount of drug or preparation required to produce some specific effect upon the intact animal

Methods based upon the amount of drug or preparation required to produce a definite effect on an isolated organ

Cannabis

Characteristic actions of the drug

Effects of large doses on the dog

- Selection of animals
- Study of peculiarities of each animal
- Method of determining unsusceptibility of animals
- Preparation of experiment
- Preparation of the drug
- Method of administering drug
- Construction of observation cages or rooms
- Assay process
- End reaction
- Standard
- Personal equation
- Accuracy of test

Cardiac stimulants and depressants

Stimulants

- Distinguishing features of
- Action on the heart
- Three stages of digitalis action
- Heart lever
- Frog board
- Single drum kymograph
- Methods of smoking drums
- Methods of recording actions of stimulants and depressants on frog's heart
- Effect on blood pressure
- Method of fixing charts

Depressants

- Principal actions
- Effect on the frog's heart
- Effect on blood pressure

Aconite

Method of assay

- Apparatus necessary for experiment
- Animals
- Preparation of solutions
- Hitchens' syringe
- Method of injecting animals
- Assay process
- End reaction

Method of recording results

Standard

Sensitiveness test

Digitalis, strophanthus, squill

Method of assay ("One Hour Frog" Method)

Frogs

Species

Size

Storage

Seasonal variation in susceptibility

Apparatus necessary

Preparation of experiment

Preparation of solutions

Dosage

Method of injecting

Pithing

Method of exposing heart

End reaction

Variation in rate of absorption

Necessity for constant temperature bath

Thermo-regulators

Assay process

Ouabain

Necessity for and use of as standard for determining
susceptibility of frogs

Standards

Suprarenal glands

Action on blood vessels

" on circulation

" on cardiac muscle

Animals

Apparatus necessary

Long paper kymograph

Method of smoking

Manometer

Pressure bottle

Solutions to prevent clotting

All-glass syringe

Scalpels

Grooved director
Hemostat
Glass seekers
Artery clamps
Cannulæ
 Vessel
 Tracheal
Ligatures
Dog Board
Artificial respiration pump

Anæsthetics

Ether
Chloroform
Morphine-acetone-chloroform
Necessity for maintaining an even degree of anæsthesia
Method of exposing carotid artery, femoral veins and trachea
Method of connecting apparatus with animal
Lævo-methylamino-ethanol-catechol
Preparation of standard solution
Preparation of unknown solution
Method of injecting
Complete and abbreviated tracings
Assay process
Determination of proper dose of standard solution
Comparison of unknown with standard solution
Reasons for calculating percentage strength upon doses required to produce equal rises rather than upon the rises produced by equal doses
Accuracy of test
Reason for alternately injecting standard and unknown solution
Reasons for using submaximum rise
Reasons for using almost the maximum rise for the standard of comparison
Method of measuring rises and reasons for doubling same

Liquor hypophysis

Pituitary body

Structure

Size

Composition

Role in life

Action on diuresis

“ on blood pressure

“ on uterine contractions

“ on mammary glands

Actions best adapted to standardization purposes

Isolated uterus method

Apparatus necessary for

Arrangement of

Loche's solution

Method of excising uterus

Method of suspending uterus in apparatus

Variation in muscular structure of different uteri

Mutual relation as to power and muscular structure

Use of escapement wheel and counterpoise bucket

Addition of shot to increase tension on uterus and
control amplitude of normal contractions

Rhythmic and tonic contractions

Beta-iminazoly-ethylamine hydrochloride

Preparation of standard solution

Preparation of unknown solution

Assay process

Determination of proper dose of standard solution

Uniformity of interval between doses

Life of uterus in apparatus

Accuracy of test

Standard

Advantages over blood pressure method

IMMUNOLOGY. Twenty-five hours.

The course outlined is to be covered in approximately ten sessions of two to three hours each and is to consist of lectures and demonstrations by the instructor and such laboratory work as can be conveniently performed by the students.

The lectures should cover the theories of infection, of disease processes, of immunity; the rationale upon which biologic therapy is based; the theory and mechanism of immune reactions; and the preparation, testing, distribution and use of various biologic products. The laboratory course should be such as to familiarize the students with the technic involved in carrying out immunologic reactions and for testing the potency and purity of biologic products. The lectures and demonstrations should cover the following:

The factors governing infection, including the classification of disease-producing bacteria and the factors upon which depend the invasiveness of various species

The physiologic basis of morbid symptoms, and the pathologic changes caused by pathogenic bacteria.

General classification and discussion of various kinds of immunity.

A. Detailed discussion of passive immunity, its mechanism, advantages, disadvantages.

B. Active immunity, its mechanism, advantages, disadvantages.

C. Detailed discussion of the theories of immunity, with special consideration of the various types of immune bodies and their immunologic reactions.

Antitoxic sera. Theoretical basis, method of production, tests for potency and purity.

Antibacterial sera. Theoretical basis, method of production, tests for potency and purity.

Vaccines, including the history, method of preparation, potency and purity tests. Smallpox vaccine, bacterial vaccines and such preparations as tuberculin and mallein, pollen proteins and food proteins.

Biologic agents in veterinary practice, particularly the preparation and use of tuberculin and mallein, with discussion of the economic aspects of these two reagents.

The theory, preparation and testing of reagents for the Schick reaction, and for active immunization against diphtheria.

The theory of complement fixation, with the technic of such modifications as the Wassermann reaction, etc., with the consideration of its economic uses.

Consideration of the physical characters and keeping qualities of biologic products and the obligations of the dispensing pharmacist in their proper distribution.

DISPENSING PHARMACY. Seventy-five hours.

The extemporaneous compounding of prescriptions. This work should include the compounding of the most complicated prescriptions and those requiring the greatest skill and most perfect technic.

Compatible prescriptions

The perfect solution

The thoroughly mixed powder

The smooth ointment

The well-spread plaster

The stable compressed tablet and tablet triturate

The perfectly formed pill, troche and suppository

Incompatible prescriptions

Physical incompatibility that cannot be overcome

Physical incompatibility that can be modified

Physical incompatibility that can be prevented

Chemical incompatibility

Intentional

Unintentional

Harmful

Useless

Prescriptions

Emulsions, perfect suspension

Capsules, hard and elastic

Powders, in bottles, in papers, in cachets

Pills, coated with sugar, gelatin, tolu, keratin, salol

Ointments, in jars, in collapsible tubes, in papers

Ampoules

Solutions, sterilized

Solutions requiring dark-colored bottles, glass-stoppered bottles, rubber-stoppered bottles

Saturated solutions

Percentage solutions

Labeling

Wrapping

Section III. Examinations

This section comprises suggestions on methods of examination, some of which are illustrated by sample questions.

It has not been the object to present a large number of questions, but to choose those which will illustrate some of the good points and some of the poor points of examinations and thereby suggest some things which all may not have considered. Some general statements have been formulated which should govern every examiner in framing questions.

In selecting the questions which follow it has been the desire to consider questions which are suitable for boards of pharmacy examinations. However, in framing questions, the examiner on the Board of Pharmacy must always keep in mind the fact that applicants for registration have received their knowledge in different ways and from different sources and that the questions asked must be those which the applicant should be able to answer if he is competent to practice pharmacy. Occasionally we are forced to believe that the examiner has not given the attention and thought to the questions which he should have given.

General statements

1. Questions should not be ambiguous but should be so clearly and distinctly worded that they cannot be misunderstood.

2. Questions should be of such a nature that they cannot be answered by "Yes" or "No," unless perhaps in an oral quiz.

3. Questions should be of such a nature that the examinee cannot ramble on without giving a definite answer. Commencing a question with "Discuss" or "Tell all you know" is likely to bring out an indefinite answer. In answering such a question the applicant may feel certain that he has done credit to himself when in fact he may have missed the point entirely.

4. Quite a number of questions should be so worded that they will not involve memory effort alone; so worded that the person answering them must do some reasoning. The candidate usually succeeds better by reasoning, if he is capable of it,

than by answering questions from memory, and the answer to a question requiring reasoning is rarely the result of pure guess work. Such a question may well begin with "Why."

5. Questions should be so worded as to require a wider knowledge of the subject than the direct answer indicates. For example, in answering the question "Why does Fowler's solution give a precipitate with solutions of most alkaloidal salts?" the applicant must know what Fowler's solution is, its composition, its reaction to litmus, that the acids of the alkaloidal salts have a stronger affinity for the alkali than for the alkaloids, and that free alkaloids are sparingly soluble in water.

6. Some questions should deal with the general aspects of their subjects, rather than with details.

7. In general, some credit should be allowed in grading an answer where it is partly right and partly wrong; e. g., in a problem when the method is right and the answer wrong, except that in problems involving doses of potent remedies it should be required that all work including the answer should be correct.

8. Questions involving mathematics should have all the data as to atomic weight, specific gravity, etc., included.

9. Catch questions should be avoided. Some examiners contend that catch questions are a test of acuteness of mind and therefore permissible. However, a properly constructed question paper gives ample latitude for testing acuteness of mind without the use of catch questions.

10. Questions prepared by different members of a board should be reviewed by one member for the purpose of eliminating duplicates and of preventing one examiner from trespassing on another's subject. There should be no duplication, and no questions should be asked which are partially answered in other questions.

11. In states where there is no prerequisite law, it is entirely proper for the board to ask questions on subjects which are included in college of pharmacy courses, provided the subjects should be known by a practicing pharmacist.

12. Questions should cover a wide scope and should not be limited to the most commonly used drugs and preparations.

13. Questions should avoid disputed or doubtful ground.

14. Questions on microscopical appearance of drugs should not be asked, except in states having college of pharmacy graduation requirements, where such questions are permissible.

15. Questions on therapeutics should be limited to the general action and use of drugs and should not be of such a character as to test the applicant's fitness to prescribe the use of drugs in treatment of disease.

16. Questions on doses should form a very important part of every examination. In general the U. S. P. average dose should be requested, with special emphasis on those drugs for which the U. S. P. specifies two or more doses. These questions on posology should be supplemented by other questions on the maximum doses of potent or toxic drugs. The pharmacist should know positively when the average maximum dose of a potent remedy is exceeded.

17. Questions on bacteriology, disinfection, and biologic products should be asked, especially in states having college of pharmacy graduation requirements.

18. Questions in commercial pharmacy, if given at all, should be very limited. The purpose of the various pharmacy laws is to prevent the unqualified from practicing. It is not the function of the examination to test the applicant's qualifications as a business man.

19. There is no agreement on the custom in some states of allowing the selection of a certain number of questions from the set given (say ten from twelve or fifteen) and no recommendation on this custom can be made until some general agreement on it is reached.

20. A sufficient number of questions should be asked on each subject in examination to permit of balanced distribution. For instance, 20 questions in Pharmacy, 20 in Materia Medica, 10 in Chemistry, 10 in Pharmaceutical and Chemical problems.

21. Questions on pharmaceutical arithmetic should be given in a separate set, because if distributed through the subjects of chemistry, pharmacy, and materia medica, the applicant may get a passing grade without knowing anything about this subject. The solution of arithmetical problems should not be made dependent upon a knowledge of chemistry, pharmacy, or materia medica.

QUESTIONS WITH COMMENTS

Pharmacy

1. (a) Why is an excess of lime kept in the lime water container? (b) Why is glycerin used only in the first part of the menstruum in making fluidextracts by "type process B"? (c) Why is potassium iodide used in making Lugol's solution? (d) Why is diluted hypophosphorous acid used in making syrup of ferrous iodide?

Comment: The divisions of the question above are well constructed, as the applicant must know a great deal about the preparations before he can give a reason; but so many unrelated products should not be grouped under one question. A better construction would be: 1. (a) Outline process for making official lime water. (b) Why is an excess of calcium hydroxide kept in the lime water container? 2. (a) Outline the process of making official fluidextract of digitalis. (b) Why is glycerin used only in the first part of the menstruum in making fluidextracts by "type process B"?

2. (a) How much ethyl nitrite is there in spirit of nitrous ether? (b) What ingredients in the formula react to make ethyl nitrite? (c) Why is sodium carbonate used? (d) Why is potassium carbonate used? (e) Why does this preparation sometimes effervesce with ammonium carbonate?

Comment: On the whole, this question is a good one, but too long. Too many divisions. Better make two divisions, covering most important facts. If the applicant can answer these, it is fair to assume he can answer the rest.

3. Tell all you know about adeps lanæ and compare it with adeps lanæ hydrosus.

Comment: To ask a person to tell all he knows on a subject is too indefinite and unsatisfactory; in place of the second part it would be better to ask for the essential differences between adeps lanæ and adeps lanæ hydrosus.

4. (a) Name the official substances obtained from petroleum. (b) What advantage has petrolatum over lard and other fats as an ointment base?

Comment: A part of the answer for (a) is given in (b). Such cases should be avoided.

5. Give the formula for Basham's mixture.

Comment: For common preparations it is well to ask for the ingredients, though not for the amounts except in the case of a very active agent.

6. (a) Give the process for making syrup of ferrous iodide. (b) Name the ingredients used and state which one is used in excess, and why.

Comment: The general methods for making such common preparations should be known, but not necessarily the details.

7. (a) What are mucilages? (b) Name those official.

Comment: Change part (a) of question to read: "Define mucilages." "What are mucilages?" may be truthfully answered in a number of ways, such as, "solution of a gum; a sticky liquid," etc., without bringing out what is wanted. "Define mucilages," however, calls for a class definition. Part (b) of the question should be stated so as to require a definite answer, as should all questions of this type. As written, the applicant may be in doubt as to whether he has named all that are official. It would be better to ask for a specific number, as, for instance, "Name one U. S. P. and one N. F.," or "Name two U. S. P."

8. What is the official Latin name of (a) Hoffman's anodyne, (b) Carron oil, (c) Goulard's extract, (d) Fowler's solution?

Comment: The pharmacist should know thoroughly all synonyms which he is likely to meet. The fact that he can place a preparation when it is called for under one of its synonyms increases the confidence of the patient and the physician.

9. Give a type process for making a fluidextract.

Comment: It would be better to ask applicant to describe a type process, name a fluidextract made by that process and give reason for the successive steps.

10. Criticize the following prescription:

R.

Corrosive sublimate	gr. ij
Potassium iodide	3 vj
Tinct. ferric chloride	f 3 ss
Tinct. nux vomica	f 3 ij
Tinct. cinchona comp. q. s. ad.	f 3 iv

M. S. Teaspoonful in water after meals.

Comment: When a criticism is asked for, a student does not know how much to write. It would be better to put the question as follows: (a) Give principal incompatibilities. (b) Give in detail the method and order of filling this prescription, or if you would not fill it, give your reasons.

Pharmaceutical arithmetic

1. (a) Convert the following into the metric system:

R.

Quininæ sulph.	gr. xxiv
Acidi sulph. arom.	f 3 ij
Syr. aurantii	f 3 ss
Aqua q. s. ad.	f 3 iv

- (b) Convert the following into apothecaries' measures:

R.

Quininae sulph.	4.0
Ferri phos.	3.1
Strychninæ sulph.	0.065
Arseni triox.	0.1
Elixir arom. q. s. ad.	250.0

2. (a) Boric acid is soluble in 18 parts of water; what is the percentage strength of a saturated solution? (b) How much 4% cocaine hydrochloride solution can be made from a 1/8-oz. vial of cocaine hydrochloride?

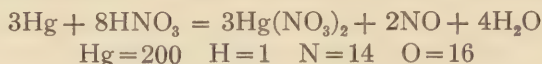
3. Four fluid ounces of a stock solution contain 120 grains of mercuric chloride. How many minims of this stock solution should be used in making one gallon of a solution 1:1000?

4. Compound spirit of ether contains:

325 cc. ether	sp. gr. 0.715
650 cc. alcohol	" " 0.809
25 cc. ethereal oil	" " 0.905

What is the specific gravity of the compound spirit of ether?

5. How many grams of 68% nitric acid are required to convert 28 grams of metallic mercury into mercuric nitrate?



6. An extract of *nux vomica* contains 45% moisture and 11% alkaloids; how much starch must be added to 1 lb. of the extract after it has been dried to make an extract containing 16% alkaloids?

Chemistry

1. Define chemistry, acids, bases, salts, basic salts, atom, molecule.

Comment: This type of definition should be omitted from examinations for full registration and they should be used to only a very limited extent in examinations for assistant pharmacists. They are so frequently asked that everyone cramming for examination will memorize them, although he may have practically no knowledge of chemistry.

2. Hydrogen dioxide. (a) Give the graphic formula. (b) Describe the manufacture of the official solution. (c) With what is the commercial solution frequently preserved? (d) How is the strength determined?

Comment: Graphic formulas should not be asked for on board examinations, except for some of the simpler organic compounds. (b) and (d) should be replaced by questions which come more into the pharmacist's regular work.

3. Iodine. (a) What reactions take place in making the so-called colorless tincture of iodine? (b) What is formed when ammonia water is added to iodine? (c) What is the most delicate test for the detection of iodine in such a liquid as syrup of ferrous iodide?

Comment: (a) and (b) should not be asked in the same set of questions, as (b) is included in (a). In (c) the examiner probably wanted the starch paste test, but shaking with chloroform is also very delicate. In wording the question it would be better to replace the words "the most" by "a."

4. What reactions take place in making (a) syrup of ferrous iodide, (b) spirit of Mindererus, (c) Labarraque's solution, (d) compound solution of cresol.

Comment: This is a good question in the application of chemistry to practical pharmacy, but two parts should be sufficient in such questions.

5. Give the solubility in water and in alcohol of (a) potassium iodide, (b) mercuric chloride, (c) potassium acetate, (d) quinine sulphate, (e) boric acid.

Comment: Pharmacists should know the approximate solubility of common salts, but not necessarily the exact figure.

6. How are the following assayed: (a) ammonia, (b) tincture of iodine, (c) laudanum?

Comment: While the applicant should understand the principles embraced in assay processes, and should know in general the method, he should not be expected to give detailed description of processes, as he would have the Pharmacopœia at hand in making an assay.

7. By what means can you tell the difference between (a) oxalic acid and Epsom salt, (b) morphine sulphate and quinine sulphate, (c) benzoic acid and salicylic acid?

Comment: This question is indefinite and should be changed to read: "How distinguish by chemical and physical tests between (a) oxalic acid and Epsom salt; (b) morphine sulphate and quinine sulphate; (c) benzoic acid and salicylic acid.

8. Describe tests for the identification of (a) potassium iodide, (b) calcium phosphate.

Comment: This is a good general question on qualitative analysis. Better, however, to recast it so the applicant will be required to give a chemical test. Also, it would be better to substitute some salt more commonly used than calcium phosphate, such, for instance, as ferric phosphate. Any applicant having a knowledge of pharmacy should be able to make such simple chemical tests.

9. (a) What is formaldehyde? (b) What is salol? (c) What is formed when an acid acts on a base?

Comment: "Formaldehyde is a liquid used as a germicide," "salol is a white powder with a peculiar odor which is prescribed by doctors as an intestinal antiseptic.," "Water is formed when an acid acts on a base" will be commonly given in answer to a question phrased as is this one, and such answers are not acceptable. The question should be recast so as to bring out the candidate's knowledge of the chemical composition of formaldehyde and salol; and the complete reaction when an acid acts on a base. "c" part should also include "Give example."

10. (a) Why is a solution of mercuric chloride poured into lime water, and not lime water into mercuric chloride solution, in making yellow wash? (b) Why is a solution of ferric sulphate poured into ammonia and not ammonia into ferric sulphate in making ferric hydroxide? (c) Why are ammonium carbonate and ammonia water allowed to stand together for twelve hours in making aromatic spirit of ammonia?

Comment: This is a good type of question, but two of the three parts are ample for one question.

Botany

1. Define the following terms: (a) botany, (b) phyllotaxy, (c) thallophytes, (d) spermatophytes.

2. (a) How does a rhizome differ from a tuber? (b) How does a saprophytic differ from a parasitic root?

3. (a) What are stomata and what is their function? (b) How do glandular and nonglandular trichomes differ in appearance and function?

4. (a) What is a glabrous leaf, (b) a coriaceous leaf, (c) a punctate leaf, (d) what tissues enter into the structure of a leaf?

5. What is meant by (a) sessile flower, (b) deciduous, (c) corm, (d) dehiscent fruit?

Comment: In order to read descriptions of drugs intelligently, a knowledge of terms used is essential and boards should give the subject of botany more attention.

Pharmacognosy

1. Belladonna root. (a) What is the family of the plant yielding this drug? (b) Give U. S. P. definition. (c) Describe the plant yielding it. (d) Write the macroscopical and microscopical description of it. (e) Name the active principles. (f) Give the habitat. (g) Name some adulterants.

Comment: (a) Asking for family is not necessary as it is included in U. S. P. definition, asked for in "b". Family should not be asked for alone. (c) The description of belladonna plant should not be required, as it is grown in only a few localities in the United States. (d) Neither the macroscopical nor the microscopical description should be required except in those states having graduate in pharmacy requirements,

and hence only graduates on examination. In such states, questions requiring microscopic description are permissible, but should be confined to drugs commonly evaluated by microscopic appearance. Candidates should know the usual adulterants of common drugs, and should be able to outline the U. S. P. definitions, give potent active principles and the general habitat of the more important official plant drugs.

2. Give the Latin official name of (a) may apple, (b) monks hood, (c) henbane, (d) black haw, (e) pink root.

Comment: Synonyms should be known. Question could be improved by asking for Latin official name in some of the divisions and giving Latin official names and asking for synonyms on others, or else make two questions, one asking for synonyms, the other asking for official Latin titles.

3. Name the plants from which the following are obtained: (a) emodin, (b) punicine, (c) eserine, (d) sparteine, (e) atropine.

Comment: A good question. Either the Latin or common name should be acceptable.

4. Name the more important poisonous and medicinal plants of your state.

Comment: Question might be all right if applicant was being examined in state where he was raised or educated in pharmacy, but in general the applicant should hardly be expected to know all the drugs indigenous to a particular state.

Therapeutics

1. Define (a) materia medica, (b) mydriatic, (c) idiosyncrasy, (d) synergist, (e) diaphoretic, (g) soporific.

Comment: The definitions of the therapeutic groups of drugs and medicines should be known. The examiner must keep in mind the fact that materia medica is used in the broad sense to include all we know about medicines, and in the limited sense as being synonymous with pharmacognosy.

2. Name the therapeutic groups to which the following belong: (a) santonin, (b) pilocarpine, (c) sodium phosphate, (d) strophanthin, (e) hydrastis.

Comment: Pharmacists should know the principal therapeutic groups of medicines.

3. Describe the therapeutic action and uses of: (a) chloral hydrate, (b) arsenic trioxide, (c) digitalis.

Comment: See General Statement No. 15.

4. Name (a) three vegetable cathartics, (b) two diuretics.

5. Which of the following are hypnotics, which anthelmintics, which irritants? (a) aspidium, (b) mustard, (c) iodine, (d) santonin, (e) potassium bromide, (f) sulphonal.

Comment: Both questions 4 and 5 are good.

Posology and toxicology

1. Define (a) toxicology, (b) lethal, (c) poison.

Comment: The examiner is bound to accept almost any definition of a poison even when it is a long way from an accurate one. It would be better to leave it out.

2. State the dose of (a) confection of senna, (b) pancreatin, (c) potassium acetate, (d) fluidextract of dandelion.

Comment: In asking for doses, it would be better to confine the question to more potent drugs, or at least to those having some specific medicinal action.

3. State the average dose of (a) atropine sulphate, (b) strychnine sulphate, (c) phenol, (d) cocaine hydrochloride, (e) aconitine.

Comment: See General Statement No. 16.

4. Name a physiologic antidote for (a) belladonna, (b) aconite, (c) physostigmine.

Comment: Better redraft question as follows: (a) Give a general antidote for belladonna; (b) Give a physiologic antidote for belladonna.

5. Describe the treatment for poisoning by (a) strychnine, (b) phenol, (c) morphine.

Comment: The pharmacist is not expected to give full treatment in a case of poisoning. Better ask for emergency treatment.

Biologic assaying

1. Explain the difference between assaying and standardization. Define physiological standardization.

2. Can standardized tinctures or fluidextracts be made from standardized drugs? Give reasons for your answer.

3. Why is it necessary to physiologically standardize some drugs and not others? How are most drugs and chemicals standardized?

4. Give three principal *type* methods available for biologic standardization.

5. Describe the action of the digitalis group upon the frog's heart; upon the blood pressure.

Comment: Biologic assaying is well established in pharmacy, and applicants should have a general knowledge of the processes, but should not be required to give details.

Bacteriology and immunology

1. Sterilization: Name and describe each way in which it may be accomplished.

Comment: Better ask for outline of U. S. P. method for sterilizing a medicinal substance and let the applicant select the one he wants to describe. Or a definite question could be formulated requiring the applicant to describe or outline the U. S. P. process for sterilizing: (a) medicinal solutions not easily decomposed by heat; (b) medicinal solutions of substances readily decomposed by heat.

2. Describe in full how a room may be disinfected by formaldehyde; by sulphur.

3. Describe in full how agar culture medium is made (substances used, neutralization, filtering, tubing, and sterilizing).

4. What rôle do insects play in the transmission of disease? Name two diseases transmitted by mosquitoes.

5. What is an antigen, an antibody? Distinguish between antitoxic, lytic, and phagocytic immunity.

6. Diphtheria antitoxin: How is it prepared? What is the standard antitoxin unit? What is the U. S. P. dose? Can this safely be exceeded?

Comment: Every board ought to use some questions on bacteriology and immunization, because of the importance of these subjects.

Pharmaceutical jurisprudence

1. (a) What qualifications are required under the laws of your state for license to practice pharmacy? (b) If there are two grades of licentiates, what is the scope or limitation of each?

2. (a) What authorities are recognized by the U. S. government in determining the standard of quality and purity of drugs and medicines? (b) In case a drug or preparation departs from the legal standard, under what conditions may it be sold?

3. What inspectors may a pharmacist expect to visit him, and what law or laws may each be engaged in enforcing?

4. (a) What is the purpose of the Harrison Act? (b) What drugs are affected by it? (c) What are pharmacists required to do under this act?

Comment: Applicants should be familiar with laws pertaining to pharmacy, and boards should ask questions on them.

While questions on the foregoing subjects are listed under separate heads, that is for convenience in discussion, and it is not intended that a separate paper shall be given for these various topics.

Questions on toxicology, posology, therapeutics, pharmacognosy, botany, biological assaying, etc., should be combined under the general head of materia medica. They blend very nicely and it is quite appropriate to ask for the dose, action, and use of a drug or medicine under one question. Or, for instance, Give botanical source, therapeutic use, and antidote for belladonna, etc.

Jurisprudence and sterilization can be included in pharmacy to advantage.

Bacteriology and immunology can be given either under pharmacy or materia medica.

Practical work, actual compounding, as a separate branch or subject in examination, to carry the same weight as a single paper on written work, should constitute an important part of the examination. This practical work may consist of compounding prescriptions and preparing galenical or extemporaneous preparations, testing, etc.

A candidate who might write a first-class theoretical examination might prove quite incompetent when put in actual compounding.

Oral examination or quiz, recommended also as a separate branch or subject, to carry the same weight as a single paper on written work. In states where oral examinations form part of the applicant's test for qualifications, it has been found of the greatest value. Many times the examiner can tell more from ten or fifteen minutes' verbal quiz than can be told from written work. The candidate answering questions on the spur of the moment will often reveal his qualification or lack of it more clearly than by his written work.

These oral questions can take the form of reading and criticizing prescriptions—other than those compounded in the practical work—questions on pharmaceutical jurisprudence, a limited number of drug specimens for identification, and as a basis for questions regarding their official preparations, potent constituents, doses, or other facts concerning them.

The following rules have been adopted by the National Association of Boards of Pharmacy.

The subjects upon which applicants for registration as pharmacists, appearing before the member Boards of the respective states shall be examined, shall consist of:

Pharmacy, 20 questions, usually of not more than two divisions each, to be rated as of equal value.

Materia Medica, 20 questions, usually of not more than two divisions each, to be rated as of equal value.

Chemistry, 10 questions, usually of not more than two divisions each, to be rated as of equal value.

Pharmaceutical and Chemical Problems, 10 questions, usually of not more than two divisions each, to be rated as of equal value.

Practical Pharmacy, not less than four products, prescriptions or prescriptions and preparations, each to be rated as of equal value, or not less than three products and oral work.

Questions referring to Latin titles and synonyms, or requiring only a word or two to answer, may be increased to five divisions.

Each subject to be rated at a total of 100%.

Separate examinations to be given for assistants, consisting of the same number of questions on the same subjects as for full registration, with the same general distribution and same rating value. Questions to be more elementary and designed to establish the ability of the applicant to perform the duties to be required of an assistant.

GLOSSARY OF SOME GENERAL TERMS

Analysis. The separation of a substance into its constituents.

Gravimetric. The quantitative determination of the constituents of a substance by weighing.

Qualitative. The separation and identification of the constituents of a substance.

Quantitative. The separation of a substance into its constituents and the determination of the quantity of each.

Ultimate. The determination of the elements contained in a compound and the quantity of each.

Volumetric. The quantitative determination of the constituents of a substance by measuring their reactions with standard solutions.

Biology. The science of living organisms.

Botany. The science of plants.

Calcination. The process of strongly heating inorganic substances for the purpose of expelling volatile matter.

Chemistry. The science which treats of the specific properties and the composition of matter, the changes in composition and the laws governing such changes.

Colation. The process of removing undissolved matter from a liquid by passing the liquid through a coarsely porous medium.

Colloid. An amorphous and non-dialyzable substance.

Comminution. The process of reducing solid bodies to smaller particles.

Contusion. The crushing of fresh herbs by the process of pounding.

Crystallization. The process by which substances assume geometric forms when passing to the solid state from the gaseous or liquid state.

Decantation. The process of pouring off a liquid from a precipitate or sediment.

- Decoloration.** The process of removing color.
- Deliquescence.** Liquefaction by absorption of moisture from the air.
- Desiccation.** The process of expelling moisture from substances.
- Dialysis.** The process of separating crystallizable from noncrystallizable substances by diffusion through a porous membrane.
- Dispensatory.** A commentary on one or more pharmacopœias.
- Distillation.** The process of vaporizing a liquid and subsequently collecting the vapor by condensation.
- Drug.** A substance used as a medicine or in the preparation of a medicine.
- Effervescence.** The giving off of a gas with bubbling or foaming.
- Efflorescence.** Spontaneous loss of water of crystallization.
- Elutriation.** The process of separating a fine from a coarse powder by the use of a liquid in which the powders are insoluble.
- Evaporation.** The conversion of a liquid to a vapor without boiling.
- Expression.** The forcible separation of a liquid from a solid.
- Exsiccation.** The process of expelling water of crystallization from chemical substances by the application of heat.
- Extraction.** The separation of soluble from insoluble matter of a drug by the use of a suitable solvent.
- Filtration.** The separation of undissolved matter from a liquid by passing the liquid through a finely porous medium.
- Galenical.** Pertaining to Galen. Applied to medicines prepared by physical means only and in which chemical action does not occur.
- Garbling.** Removing objectionable matter from crude drugs.

Granulation. The formation of moderate-sized particles.

Grinding. To reduce a substance to a powder by the use of a mill.

Hygroscopic. Having the property of absorbing moisture from the air.

Incineration. Heating organic matter strongly with free access of air for the purpose of obtaining its ash.

Incompatibility. Antagonism between drugs which destroys their usefulness as medicines.

Levigation. The process of reducing a substance to a fine state of division by rubbing it in a liquid in which it is not soluble.

Maceration. A process of extraction in which the comminuted drug is allowed to stand for some time mixed with and covered by a liquid.

Macroscopical. Visible to the unaided eye.

Marc. The exhausted drug which remains after a process of extraction.

Materia medica. The study of the physical, chemical, physiological, and therapeutical properties of medicines.

Medicine. One or more drugs or a preparation thereof used for the relief or cure of disease.

Menstrum. Liquid used in the process of extraction.

Metrology. The science of weights and measures.

Microscopical. Visible only by the use of the microscope.

Osmosis. The mixing of two gases or liquids by diffusion through a porous membrane.

Pasteurization. The process of destroying vegetative germs by maintaining a substance at a temperature of 60°C. to 70°C. for a limited time.

Percolate. The solution obtained by the process of percolation.

Percolation. A process of extraction by the passage of a menstrum through a column of powdered drug contained in a percolator.

- Pharmaceutical jurisprudence.** The study of laws which affect the practice of pharmacy.
- Pharmaco-dynamics.** The study of the action of medicines on the healthy organs.
- Pharmacognosy.** The art of identifying, selecting, and valuing drugs.
- Pharmacology.** The science of drugs and medicines; their nature, preparation, administration and effect, including pharmacognosy, pharmaco-dynamics, therapy-dynamics, pharmaceutical chemistry, and pharmacy.
- Pharmacopœia.** An authoritative book, establishing standards for drugs and medicines.
- Pharmacy.** The science and art of preparing, preserving, compounding, and dispensing medicines.
- Physics.** The science of the general properties of matter and the effects of energy upon matter.
- Physiology.** The science of the organic functions in the state of health.
- Posology.** The science which treats of the doses of medicines.
- Precipitation.** The process of forming an insoluble substance in a liquid.
- Pulverization.** The process of reducing a substance to a powder.
- Reagent.** A substance employed to produce a chemical change or reaction.
- Serum.** A fluid separated from the coagulated blood of an animal.
- Sifting.** Separating finer from coarser powder by the use of a sieve.
- Solute.** The substance dissolved in a solution.
- Solution.** A liquid containing dissolved matter.
- Solvent.** A liquid capable of dissolving substances.
- Specific gravity.** The relation of the weight of a definite volume of a substance to the weight of the same volume of water or hydrogen.

Sterilization. The process whereby the activity of micro-organisms is destroyed.

Sublimation. The process of vaporizing a volatile solid and collecting the vapor by condensation.

Synthesis. The process of forming a substance from its constituents.

Therapy-dynamics. The science of the action of medicines on diseased organs.

Torrefaction. The process of heating an organic substance for the purpose of modifying some of its principles.
Roasting.

Toxicology. The science of poisons, their recognition, effects, and antidotes.

Trituration. The process of reducing a substance to a powder by rubbing.

Trochiscation. The process of forming conical masses from levigated or elutriated substances.

Vaccine. A biological product which, when administered to a subject, will communicate a specific disease in a mild form and thus render the subject immune to a more virulent form of the disease.

Vegetable histology. The science of the cellular constitution and structure of plants.

Weight. The comparative force with which a body is attracted toward the center of the earth.

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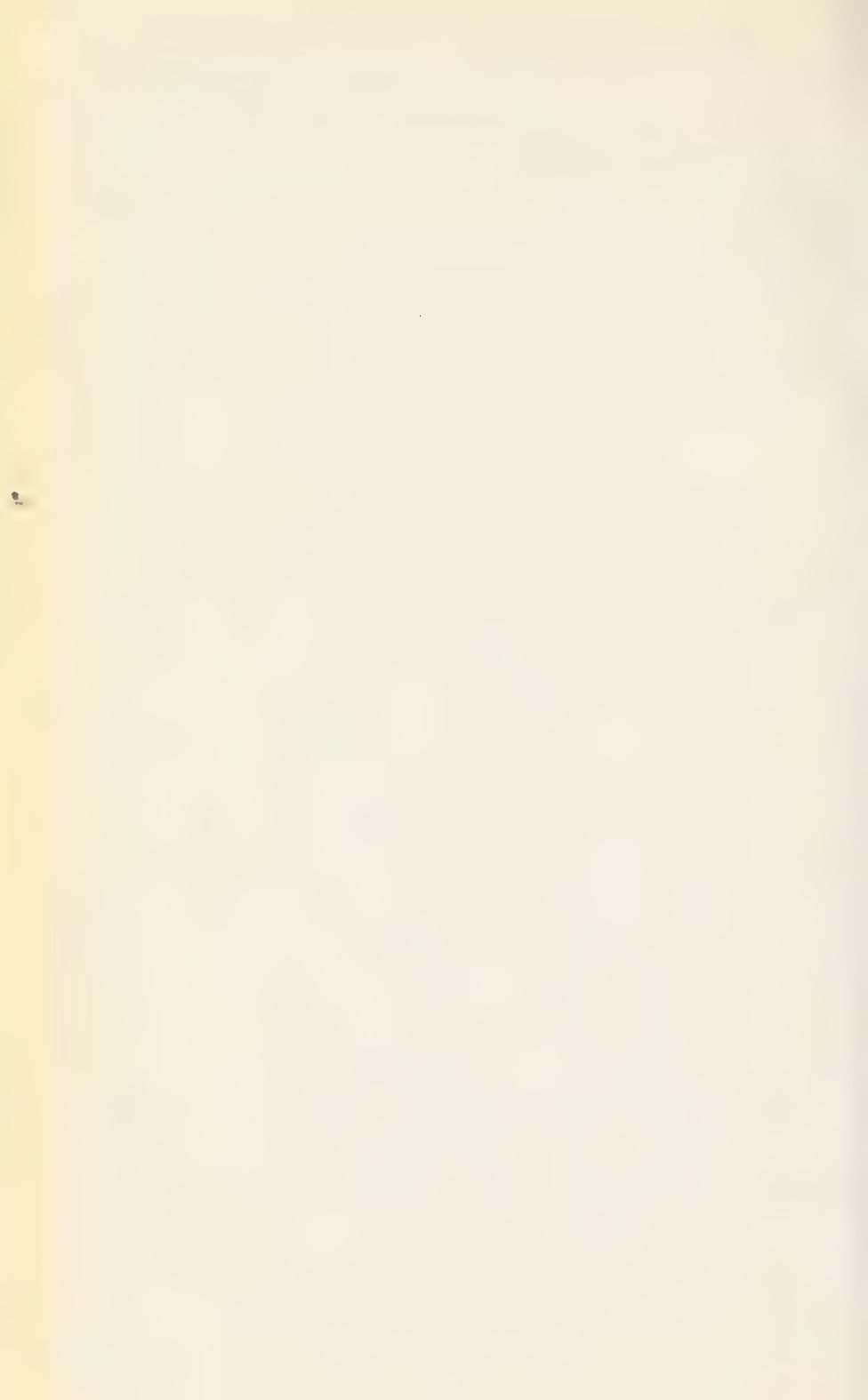
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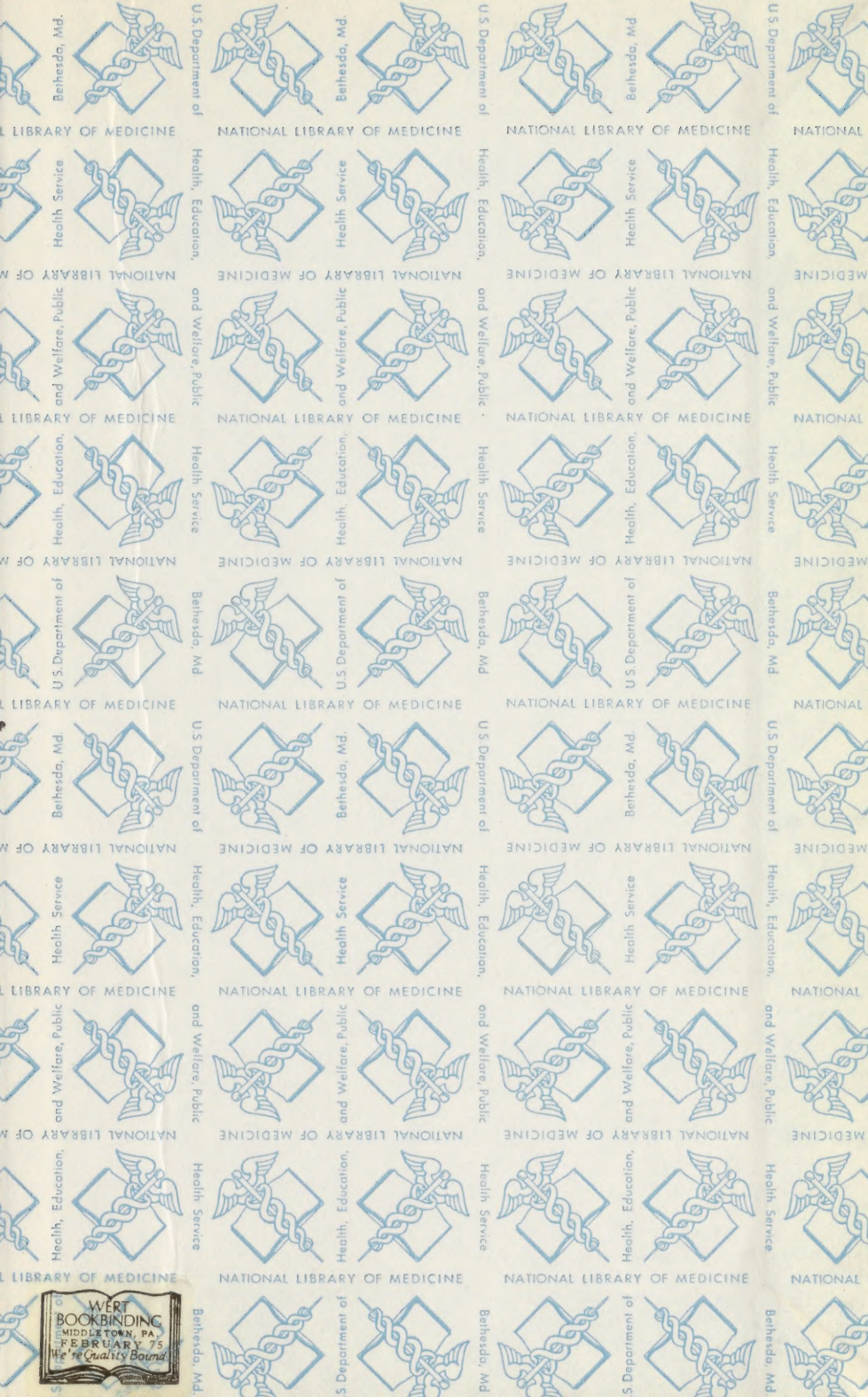
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